



Veterans Affairs Medical Center Pollution Prevention Assessment

**VETERANS AFFAIRS MEDICAL CENTER
POLLUTION PREVENTION ASSESSMENT**

Final Report

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1.0 INTRODUCTION

This report presents the results of a pollution prevention (P2) assessment of the Denver Veterans Affairs Medical Center (VAMC). The P2 assessment was conducted by personnel from U.S. Environmental Protection Agency (EPA) Region 8, its contractor, Tetra Tech EM Inc. (Tetra Tech), and the Denver VAMC. The scope of the P2 assessment included all hospital and facility operations except for research laboratories and restaurants. The P2 assessment had two primary objectives: (1) document current P2 practices, and (2) identify P2 opportunities. P2 practices and opportunities for this assessment include techniques, technologies, and programs that reduce the quantity or toxicity of wastes generated, enable waste recycling, or conserve natural resources.

The following sections discuss the Denver VAMC and the environmental aspects of its operations (Section 2.0), describe current P2 practices observed during the assessment (Section 3.0), present three proposed P2 projects for VAMC's consideration (Section 4.0), and list other P2 opportunities identified by the assessment (Section 5.0).

2.0 DENVER VAMC BACKGROUND AND ENVIRONMENTAL ASPECTS

VAMC is a multibuilding complex located at 1055 Clermont Street in Denver, Colorado. The facility consists of patient wards; surgical facilities; clinical, radiology, histology, and research laboratories; pharmacy; morgue; nursing home; office space; maintenance facilities; and a food court and kitchen. A map of the facility is provided in Appendix 1. General background information about the Denver VAMC is summarized below. A photograph of the main building of the VAMC complex is shown in Figure 2-1.

**TABLE 2-1
DENVER VAMC BACKGROUND INFORMATION**

Number of beds	272 plus 60 in nursing home
Average bed occupancy	73.5 percent
Facility property size	12 acres
Number of buildings in complex	21 buildings
Total floor space under roof	540,000 square feet in main building
Age of facility	40 years
Number of full-time employees	1,270
Number of part-time employees	180
Environmental staff	3 full time, 1 part time

FIGURE 2-1

VAMC COMPLEX MAIN BUILDING



The major environmental aspects of Denver VAMC operations were investigated initially as a basis for selecting P2 assessment focus areas and identifying P2 opportunities. The environmental aspects investigated include water use and wastewater discharge, hazardous materials, hazardous wastes, and infectious waste. Wherever possible, P2 opportunities that compliment the Department of Veterans Affairs (VA) P2 Strategy have been incorporated (see Appendix 2). The process and sources of information Tetra Tech used for the initial investigation are described in the following sections.

2.1 WATER USE AND WASTEWATER DISCHARGE

Water bills from fiscal year 1997 (October 1996 through September 1997) were reviewed to calculate average monthly water use. During that period, the average monthly water use was 3,502,200 gallons. The average monthly water purchase and sewer discharge costs were \$4,062 and \$6,829, respectively.

Denver VAMC uses water for numerous purposes. According to a 1991 VAMC water audit conducted by the Denver Water Department, the areas of greatest water use were domestic (sink, toilet, and shower use), heating and cooling. Water is also used in grounds irrigation. The audit report concluded that the greatest savings in water costs could be realized by reducing domestic and once-through cooling water use. The report suggested installing flow restrictors on flush-valve toilets, replacing tank toilets with low-volume toilets, installing aerators on sink faucets, and eliminating all once-through cooling units through use of close-loop systems and equipment retrofit or retirement. The Denver Water Department planned a follow up evaluation of the report's recommendations, but it was not executed because no action had been taken on the recommendations 6 months or 1 year following the audit.

All wastewater from VAMC operations is discharged to the wastewater treatment plant (WWTP) Denver Metro Wastewater Reclamation District (Denver Metro) via a sanitary sewer. The facility is not required to obtain a discharge permit. Various areas of VAMC discharge a variety of chemicals to the sewer. While the assessment team confirmed that Denver Metro accepts all chemicals discharged by the Medical Center to the WWTP, disposal of chemicals to the sewer is not a pollution prevention practice.

2.2 HAZARDOUS MATERIALS

A variety of hazardous materials are used by several Denver VAMC departments. A summary of hazardous material use is presented in Table 2-2 and discussed below. This table is not a comprehensive list of all hazardous materials used at VAMC. Instead, it is a list of hazardous materials that were focused on during assessment team visits to the facility.

2.2.1 Histology Laboratory and Morgue

The histology laboratory and morgue use about 110 liters (L) of formalin (formaldehyde and water) per month for tissue and organ sample preservation. Tissue samples are stored in 15 to 180 milliliter (mL) biopsy containers prepackaged with a 10 percent formalin solution. Organ samples are stored in 5-gallon closed buckets that contain 1 to 2 gallons of a 10 percent formalin solution. Samples are typically stored on site for about 6 months. When the samples are disposed of, waste formalin is flushed down the drain with running water. Although no formal standard operating procedure (SOPs) exist for drain disposal, employees are all directed to flush with "copious amounts of water." This disposal practice is acceptable from a regulatory perspective. However, drain disposal is not a desirable practice from a P2 perspective, which aims fundamentally at source reduction. Laboratory personnel estimated the waste formalin generation rate is 600 mL per day from tissue samples and 60 to 120 L from organ samples every 3 months.

TABLE 2-2
HAZARDOUS MATERIALS USED AT DENVER VAMC

Department	Hazardous Material(s)	Use
Histology Laboratory and Morgue	<ul style="list-style-type: none"> Formalin (formaldehyde) Xylene, toluene, various alcohols, and other organic solvents Miscellaneous chemicals 	<ul style="list-style-type: none"> Tissue preservative Tissue staining Tissue staining
Clinical Laboratory	<ul style="list-style-type: none"> Methanol 	<ul style="list-style-type: none"> Slide staining
Radiology	<ul style="list-style-type: none"> Silver-containing developers 	<ul style="list-style-type: none"> X-ray developing
Facility Maintenance	<ul style="list-style-type: none"> Petroleum distillate "Virginia 10" (petroleum distillate containing perchloroethylene and methylene chloride) R-12 and R-22 refrigerant gases 	<ul style="list-style-type: none"> Parts degreasing/cleaning Parts degreasing/cleaning Air cooling systems
Operating Room Cardiology Gastrointestinal Laboratory Ear, Nose, and Throat	<ul style="list-style-type: none"> Glutaraldehyde Ethylene Oxide 	<ul style="list-style-type: none"> Equipment sterilization Equipment sterilization

The histology laboratory is currently evaluating less toxic formalin substitutes. Detailed information about the formalin substitution is provided in Section 4.2.

Historically, the histology laboratory used toluene, xylene, various alcohols, and other solvents in several staining processes. Before 1986, xylene use decreased significantly as a result of a less toxic substitute Hemo-De (see Section 3.1). A wide variety of solvents and chemicals are used for special staining; however, use of these chemicals declined when the laboratory installed an automatic staining machine (see Section 3.3). All staining processes are carried out under a ventilated hood, and waste organic solvents used for staining are disposed of down a sink with running water. Although no formal SOPs exist for drain disposal, employees are all directed to flush with "copious amounts of water." This disposal practice is acceptable from a regulatory perspective. However, drain disposal is not a desirable practice from a P2 perspective, which aims fundamentally at source reduction.

2.2.2 Clinical Laboratory

The clinical laboratory hematology division also uses staining procedures. Methanol is used as a rinse step in the staining process. About 500 mL of methanol is used per day in the staining process. Before the waste methanol is disposed of, it is reused to clean stain from slide racks. Waste methanol is ultimately disposed of down a sink with running water. Although no formal SOPs exist for drain disposal, employees are all directed to flush with "copious amounts of water." This disposal practice is acceptable from a regulatory perspective. However, drain disposal is not a desirable practice from a P2 perspective, which aims fundamentally at source reduction.

2.2.3 Radiology

Medical, dental, and research x-ray films are developed in film processing units that use silver-containing developing solution. Spent developing solutions from the processing units are combined in a holding tank and batch treated to remove the silver. Primary treatment is accomplished using electrolytic silver removal that involves electroplating metallic silver onto inert cathodes. A 30-gallon batch is treated in 8 hours. Cathodes are removed from the primary treatment unit about every 2 months, when silver deposition reaches 0.5 inch thick. Effluent from the primary treatment unit is pumped to a holding tank and then through a secondary treatment unit that removes any residual silver. The secondary treatment unit consists of two silver-scavenging filters arranged in series. Treated spent developing solution is discharged to the sanitary sewer via a drain in the treatment room.

2.2.4 Facility Maintenance

The facility maintenance department is organized according to the following maintenance shops: heating, ventilation, and air conditioning (HVAC); transport; grounds; paint; metal; carpentry; plumbing; beds; and electrical. Many facility maintenance activities that involve hazardous materials are contracted to external organizations; for example, no vehicles are repaired on site. Other shops have phased out or are phasing out hazardous materials. For example, the HVAC shop has substituted the refrigerant in the chillers, replacing R-11 with R-123. R-11 is a Class I ozone depleting substance (ODS). R-123 is a Class 2 ODS and is less detrimental to the ozone layer. However, the HVAC shop does maintain a small R-12 and R-22 inventory to top-off air conditioners.

The paint shop uses only latex paint and has reduced its painting requirements. The Medical Center has been painted with a standardized, limited set of paint colors. Paint colors can be chosen from a color board designed by the facility's interior decorator. By standardizing the number of colors of paint available, paint is not over purchased. Overstock of paint can lead to paint expiration that requires disposal. Since one paint color has multiple uses throughout the facility, paint that is left over after one paint order it can be used on another order before it expires. Paint use and labor expenditures are also minimized by establishing that only one base color of paint be used on the main walls throughout the facility. By not changing the color of the base wall paint, touch ups require only one coat of paint instead of the two coats required when paint colors are changed. In addition, the VAMC has switched from using paint to adhesive vinyl tape for roadway crosswalks. They found the vinyl tape lasts twice as long as the painted crosswalks.

Hazardous materials are used primarily by the metal shop, which operates a solvent-based parts cleaning unit. The part cleaning unit uses a petroleum distillate solvent. The cleaning unit is a sink-top unit equipped with a spray. Cleaning solvent is held in a 20-gallon drum that contains a 12.5-gallon reservoir of solvent floating on a small volume of water. Solvent is pumped into the cleaning sink through the spray gun and drains back to the 20-gallon drum. Inorganics and soil settle out of the solvent into the water at the bottom of the drum and solvent is reused. Fresh solvent is periodically added to make up for evaporative losses. Solvent in the reservoir becomes spent and is disposed of off-site about once per year. See Section 4.3 for detailed information about replacements for the petroleum distillate solvent unit.

The metal shop also maintains a flammable materials locker that contains several 1-gallon cans of "Virginia 10 Degreasing Solvent." This solvent is a petroleum distillate that contains aliphatic solvent naphtha, propylene glycol propyl ether, n-methyl pyrrolidone, and monoethanolamine. Shop personnel reported that this solvent is used sporadically when small parts such as ball bearings require stringent cleaning. Maintenance personnel noted that solvent in the parts cleaning unit is sometimes too tainted with oils and grease to clean these applications effectively. Shop personnel also note that they do not require a cleaning solvent as stringent as the Virginia 10. However, they primarily use the Virginia 10 so that their stock will become depleted and they will no longer have to store this hazardous material.

2.3 HAZARDOUS WASTES

Regularly generated hazardous wastes include (1) mercury and mercury-containing devices generated by the mercury phase-out program (see Section 3.6), (2) nickel/cadmium (NiCad)-containing battery packs from operating rooms, (3) expired laboratory chemicals, (4) asbestos from abatement activities, (5) lead-based paint from abatement activities, (6) alcohols, (7) spent gas calibration cylinders, and (8) expired or unused housekeeping cleaning solvents.

The primary hazardous waste stream managed in the designated storage area is expired chemicals from the clinical, dental, and research laboratories. This waste stream is generated by periodic laboratory cleanups, old equipment decommissioning, process or procedure changes, and research laboratory project shut-downs. A flammable materials locker is located in the storage area to manage flammable solvents.

Other types of "one-time" hazardous wastes are also common. Examples observed during the P2 assessment include spray paint from a substance abuse case, absorbent pads saturated with blood and

disinfectant, chemical bottles that arrived damaged, and expired 35 percent peracetic acid from over-ordering.

2.4 INFECTIOUS WASTE

Infectious waste is defined by the State of Colorado House Bill Number 1328 as any waste capable of producing an infectious disease. For a waste to be considered infectious, “it must contain pathogens with sufficient virulence and quantity so that exposure to the waste by a susceptible host could result in disease.” The Denver VAMC considers infectious waste to be any tissue, organ, or bodily fluid or any article that has come in contact with them and meets the state definition. Articles may include petri dishes, pipette tips, protective gloves, or any other objects that may have come in contact with tissue, organs, or bodily fluids. “Sharps” are also considered infectious waste, but are placed in separate, designated containers. Sharps include items such as lancets, syringes, and needles. Infectious waste generated in the Denver VAMC is collected in red bags located throughout the VAMC.

Between October 1996 and July 1997, the Denver VAMC generated about 63.9 tons of infectious waste. The average monthly generation was 7.1 tons. Disposal costs for infectious waste were significant. During the aforementioned time period, infectious waste disposal averaged about \$4,125 per month. See Section 4.1 for a detailed discussion of infectious waste reduction opportunities.

Driven by the high volume and disposal costs of infectious waste and VAMC staff observations of waste that may have been managed as infectious waste when it didn’t need to be, VAMC is organizing a committee to address infectious waste minimization. This committee will investigate the types of waste currently placed in the red bags as infectious waste, how much waste is inappropriately placed in the red bags, and methods to reduce the amount of waste inappropriately disposed of as infectious waste.

3.0 CURRENT POLLUTION PREVENTION PRACTICES

The P2 assessment identified P2 practices in current use at Denver VAMC. These practices were documented for the purpose of technology transfer to other hospitals and to recognize VAMC administration and staff for proactive environmental management. Several of these current P2 practices are considered widely transferable to other hospitals and have significant benefits; these practices, listed below, are described in this section. Other P2 practices observed during the assessment are acknowledged in Section 3.6.

- Substitution of Hemo-De for Xylene (Section 3.0)

- Substitution of IBF for B-5 Tissue Fixative (Section 3.2)
- Automatic Staining Machine (Section 3.3)
- Substitution of Peracetic Acid for Glutaraldehyde (Section 3.4)
- Solid Waste Recycling Program (Section 3.5)

The remainder of this section provides, for each of these five P2 practices, a brief description of: (1) past and current process operation, waste generation, and costs; and (2) implementation issues. Also listed is a VAMC point of contact for additional information. Each P2 practice description includes a cost-benefit comparison for each option, with indirect benefits and concerns related to the old and new processes. Indirect costs related to these benefits and concerns are not presented because of the uncertainty in appraising their actual or approximate values. It is important to note, however, that indirect costs are real costs associated with these benefits and concerns and should not be overlooked.

3.1 SUBSTITUTION OF HEMO-DE FOR XYLENE

Description: The VAMC histology laboratory used xylene in various tissue staining procedures. The xylene was used for three processes: to allow paraffin to infiltrate specimens, to remove paraffin from specimens, and to mount a specimen to a slide. Some time before 1986, the histology laboratory substituted Hemo-De for xylene.

Past Process Operation, Waste Generation, and Costs: Xylene was used as a carrier to allow paraffin to infiltrate specimens prepared for slide development. The specimen was placed on a tissue processor and exposed to alcohol, xylene, and paraffin. A slice was cut and placed on a slide. The slide was then dipped in a series of xylene and alcohol solutions in order to remove the paraffin to view the specimen. Finally, the slide was dipped in a series of alcohol and xylene solutions in order to mount the specimen to the slide. Waste xylene was disposed of as a hazardous waste. No data are available regarding xylene use rate, purchase costs, waste generation rate, or disposal costs.

Current Process Operation, Waste Generation, and Costs: Hemo-De is a direct substitute for xylene for all three processes described above. Hemo-De contains 98 percent D-Limonene and 0.024 percent butylated hydroxyanisole and has a flash point of 49°C. The laboratory uses about 15.1 L of Hemo-De per month. The purchase cost of Hemo-De is \$7.88/L. The Hemo-De solution is reused continuously and new Hemo-De is added to the reservoir as it evaporates and is absorbed by the specimens. When the slides begin to look cloudy and the process begins to slow (about once every 2 weeks), the spent Hemo-De solution is poured down the drain with running water. Although no formal SOPs exist for drain disposal, employees are all directed to flush with “copious amounts of water.” This disposal

practice is acceptable from a regulatory perspective. However, drain disposal is not a desirable practice from a P2 perspective, which aims fundamentally at source reduction. The generation rate of waste Hemo-De is about 7.6 L per month.

Implementation Issues: Using Hemo-De instead of xylene did not impair process quality or process time. Worker health and safety conditions improved because Hemo-De is not a hazardous material.

VAMC Point of Contact: Jeannine Porter, SCT-HTL(ASCP), Supervisor of Anatomic Pathology, Pathology Department, (303) 399-8020 ext. 2751

TABLE 3-1

**VAMC POLLUTION PREVENTION ASSESSMENT SUMMARY:
SUBSTITUTION OF HEMO-DE FOR XYLENE**

	Before	After
Raw Material	Xylene	Hemo-De
Annual Use	Unknown	181.2 L
Annual Cost	Unknown	\$1,428
Waste Generation	Waste Xylene	Waste Hemo-De
Annual Quantity	Unknown	91.2 L
Management	Hazardous Waste	Poured down drain
Disposal Costs	Unknown	None
Indirect Benefits	<ul style="list-style-type: none"> • Worker familiarity 	<ul style="list-style-type: none"> • Eliminated potential worker exposure to xylene • Effective substitute that maintained process quality
Indirect Concerns	<ul style="list-style-type: none"> • Potential worker exposure to xylene • Requires tracking, proper handling and disposal 	<ul style="list-style-type: none"> • None

3.2 SUBSTITUTION OF IBF FOR B-5 TISSUE FIXATIVE

Description: The VAMC histology laboratory processes about 16 lymph node and bone marrow specimens per month. After a specimen is collected, it is placed in a fixative solution to preserve the cellular and nuclear components of the specimen for staining and subsequent analysis. Lymph node and bone marrow specimens are usually placed in a mercury-based fixative known as B-5. In April, 1994, the VAMC histology laboratory replaced B-5 with IBF Tissue Fixative (IBF), a nonmercury-based fixative.

Past Process Operation, Waste Generation, and Costs: Specimens were stored in about 15 to 100 mL of “unactivated” B-5 until the tissue was stained. Unactivated B-5 is a mixture of 12 grams of mercuric chloride and 2.5 grams of sodium acetate in 200 mL of water. Before tissue staining, about 2 mL of 37 percent formaldehyde was added to “activate” the B-5. After staining, the specimens were dipped in potassium iodide and sodium thiosulfate solution to remove the mercuric chloride from the specimen. This procedure was necessary to make the specimens visible under a microscope. About 1,050 mL of activated B-5 was used per month. The cost to purchase the unactivated B-5 ingredients was about \$160 per year. After specimen analysis, waste specimens were disposed of in designated infectious waste containers and waste B-5 was placed in a 5-gallon container, which was disposed of off-site as hazardous waste. The 5-gallon container was filled about every 18 months. Waste B-5 was disposed of as hazardous waste (D009) due to its mercuric chloride content. The cost to dispose of a 5-gallon container of mercury waste was \$500.

Current Process Operation, Waste Generation, and Costs: IBF is used as a direct substitute for activated B-5; no process modifications were necessary. About 600 mL of IBF is used per month, less than activated B-5 because IBF is used only in the histology laboratories. If a specimen is placed in a fixative outside of the histology laboratory, formaldehyde is used. VAMC may consider replacing IBF in place of formaldehyde for applications outside of the histology laboratory. The principal components of IBF are isopropanol (22 percent), formaldehyde (less than 3 percent), and methanol (less than 0.5 percent). Because there is no mercuric chloride in IBF, post-staining application of potassium iodide and sodium thiosulfate is not required. Waste IBF, a non-hazardous waste is poured down the drain after use; therefore no disposal costs are incurred. Surgipath Medical Industries, Inc. manufactures IBF. The unit cost for IBF is \$85.05 per 15 L.

Implementation Issues: Using IBF instead of B-5 to preserve specimens did not impair process quality. Worker health and safety conditions and waste management improved because IBF is not a hazardous waste. The primary implementation issue associated with the B-5 substitution involved laboratory staff acceptance of a new process chemical and concerns about process quality. The issue was resolved through testing and experience.

VAMC Point of Contact: Jeannine Porter, SCT-HTL(ASCP), Supervisor of Anatomic Pathology, Pathology Department, (303) 399-8020 ext. 2751

TABLE 3-2
VAMC POLLUTION PREVENTION ASSESSMENT SUMMARY:
SUBSTITUTION OF IBF FOR B-5

	Before	After	Annual Direct Cost Savings
RAW MATERIAL	B-5	IBF	
Annual Use	12.6 liters	7.2 liters	
Annual Cost	\$160 Unactivated ingredients	\$22	\$138
WASTE GENERATION	Waste B-5	Waste IBF	
Annual Quantity	12.6 liters	7.2 liters	
Management	Accumulated in a 5-gallon container; ultimately disposed of off site as a hazardous waste (D009)	Poured down drain	
Disposal costs	\$330 per year + staff time to track and dispose of waste	None	\$330
Total Annual Direct Cost Savings			\$468
Indirect Benefits	<ul style="list-style-type: none"> • Worker familiarity 	<ul style="list-style-type: none"> • Do not need to precipitate mercuric chloride • Eliminated worker exposure to mercury • Reduced worker exposure to formaldehyde 	
Indirect Concerns	<ul style="list-style-type: none"> • Mercuric chloride must be removed from specimens before analysis • Potential worker exposure to mercury and formaldehyde • Requires proper tracking, handling, and disposal 	<ul style="list-style-type: none"> • Need for workers to learn new tissue staining process 	

3.3 AUTOMATIC STAINING MACHINE

Description: The VAMC histology laboratory used a manual staining procedure for special stains. In October 1997, the histology laboratory received a Microprobe automatic staining machine manufactured by Curtis Matheson Scientific (CMS). This equipment reduced staining chemical use from 50 mL to 100 µL per slide.

Past Process Operation, Waste Generation, and Costs: Different procedures and chemicals are used for each special stain. In general, however, slides are dipped in a series of solutions in Copeland jars to stain the cytoplasmic and nuclear components of the specimen. VAMC spent about \$2,275 plus shipping and handling per year to purchase staining chemicals. Common special stains, the chemicals used to process the stain, annual chemical use for manual staining quantities, and disposal methods are shown in

Table 3-3. Disposal of the staining solutions varied. Some chemicals were reusable, some were poured down the drain, and five of the chemicals - methamine silver, silver nitrate, borax, potassium hydroxide, and ammonium hydroxide, were collected and disposed of as hazardous waste. Disposal of these hazardous wastes cost approximately \$240 per year.

Current Process Operation, Waste Generation, and Costs: The laboratory began using the automatic staining machine in November 1997. Chemicals for the automatic staining machine are supplied as a reagent kit. Reagent kits may be used with the automatic staining machine in place of certain special stains. The procedure implemented by the automatic staining machine depends on the stain. Generally, specimens are placed on a slide and dipped in the reagent. Capillary action draws the reagent into the specimen. The slide is then incubated for several minutes by heating to 60°C; after incubation, the slide is removed and is dabbed on an absorbent pad to remove the reagent. This process is repeated with different reagents as many times as necessary to stain the slide. The machine is provided at no cost by the company that supplies reagents to VAMC. The total cost to purchase all reagent kits is \$2,063 per year. Kits are purchased on an as needed basis and have a shelf life of about 2 years. Each reagent kit contains a predetermined set of various reagents in volumes proportional to the amount required for each staining procedure. Thus, the volumes of reagents become depleted at the same rate so there are no excess reagents left. The only waste disposed from this process is an absorbent pad, which contains trace amounts of silver nitrate and picric acid. A VAMC contractor calculated the amount of hazardous chemicals in the pads and determined that they are considered nonhazardous and may be disposed of as general refuse. The chemical savings are estimated at \$212 per year. According to VAMC personnel, the technician time savings are estimated at nearly \$27,000 per year. Disposal cost savings are estimated at approximately \$240 per year.

Implementation Issues: Using the automatic staining machine instead of manual staining procedures to stain specimens did not impair process quality. Process time was reduced because staining solutions do not have to be mixed and the automatic staining machine stains more quickly because of a heating unit that increases reaction time. Worker health and safety conditions improved because exposure to staining chemicals was eliminated. New procedures and worker training were required to use the machine. For example, the stains no longer have to be prepared, the slides do not have to be dipped in each of the solutions, technicians need to adapt to the new technology, and specimens have to be placed on the bottom third of the slide for use in the automatic staining machine.

VAMC Point of Contact: Jeannine Porter, SCT-HTL(ASCP), Supervisor of Anatomic Pathology, Pathology Department, (303) 399-8020 ext. 2751

TABLE 3-3

**VAMC POLLUTION PREVENTION ASSESSMENT
SPECIAL STAINS REPLACED BY AUTOMATIC STAINING MACHINE**

Stain	Ingredients	Annual Use	Disposal Practice
PAS	periodic acid	2,500 mL	reuse
	hydrochloric acid	410 mL	reuse
	sodium bisulfite	20 g	reuse
	light green	0.4 g	reuse
Iron	potassium ferrocyanide	100 g	sink drain, diluted
	nuclear fast red	1 g	reuse
Muci-carmin	metanil yellow	2.5 g	reuse
	carmin	10 g	drain
	aluminum chloride	84 g	drain
Elastic	ferric chloride	20 g	sink drain
	potassium iodide	4 g	sink drain
	iodine	2 g	sink drain
	sodium thiosulfate	10 g	sink drain
GMS	methamine silver	8.6 L	hazardous waste
	silver nitrate	4,320 mL	hazardous waste
	chromic acid	150 g	reuse
	borax	432 mL	sink drain
Retic	silver nitrate	50 g	hazardous waste
	potassium hydroxide	50 g	sink drain
	ammonium hydroxide	10 drops	sink drain, diluted
Trichrome	biebrich scarlet	10 g	reuse
	acid fuchsin	10 g	reuse
	glacial acetic acid	10 mL	reuse
	phosphmolybdic acid	1,120 g	sink drain
	phosphotungstic acid	1,120 g	sink drain
	aniline blue	20 g	reuse
	bouins	100 g	reuse
Alcian Blue	glacial acetic acid	30 mL	reuse
	alcian blue	10 g	reuse
	thymol	12 crystals	reuse
AFB	carbol fuchsin	620 mL	reuse
	hydrochloric acid	1,240 mL	sink drain
	methylene blue	14 g	reuse

TABLE 3-4

**VAMC POLLUTION PREVENTION ASSESSMENT SUMMARY:
AUTOMATIC STAINING MACHINE**

	Before	After	Annual Direct Cost Savings
Procedure	Manual staining	Automatic staining machine	
Annual Chemical Use	See Table 3-3 (50 mL/slide)	19 kits (mL/slide)	
Annual Chemical Cost	\$2,275 plus shipping and handling	\$2,063	\$212
Waste Generation	Miscellaneous staining chemical solutions	Waste absorbent pads	
Annual Quantity	5 g of silver nitrate in 4,320 mL of liquid solution and 200 mL of picric acid	1 pad every 3 months (estimated)	
Management	Hazardous Waste	General Refuse	
Disposal costs	\$240	Negligible	\$240
Total Annual Direct Cost Savings			\$452
Indirect Benefits	<ul style="list-style-type: none"> • Worker procedure familiarity 	<ul style="list-style-type: none"> • Shorter process time • Decrease potential for worker exposure • No bulk chemical storage • Reduced staff time for managing and ordering chemicals • Reduced staff time to track and dispose of hazardous waste • Reduced staff time to prepare and stain slides 	
Indirect Concerns	<ul style="list-style-type: none"> • Longer process time • Potential for worker exposure • Bulk chemical storage with potential for waste due to expired chemicals • Increased staff time for managing and ordering chemicals, disposing of hazardous waste • Increased staff time to prepare and stain slides 	<ul style="list-style-type: none"> • Staff must learn new technology 	

3.4 SUBSTITUTION OF PERACETIC ACID FOR GLUTARALDEHYDE

Description: The Denver VAMC Respiratory Therapy department formerly used glutaraldehyde (trade name CIDE-X) to clean respiratory therapy equipment. In September 1995, glutaraldehyde was replaced with a machine using peracetic acid (trade name Steris). Reasons for pursuing a glutaraldehyde substitute include the following: (1) glutaraldehyde has a bad odor and workers can become sensitized to it, (2) the glutaraldehyde solution had to be changed every 2 weeks, (3) glutaraldehyde residue on the respiratory therapy equipment created an unpleasant taste on mouth pieces.

Past Process Operation, Waste Generation, and Costs: Respiratory therapy equipment was first soaked in an enzymatic cleaner and rinsed in water. After rinsing, the equipment was immersed in glutaraldehyde for 20 minutes at a temperature of 24°C. The equipment was then rinsed with 0.25 percent acetic acid and sterile water, and finally placed in a drier. The entire process lasted 45 minutes. At the end of the process, the equipment was considered clean, but not sterile. Ten gallons of glutaraldehyde were used per month at a cost of \$56 to \$135 per month, depending on how the glutaraldehyde was purchased. Ten gallons of waste glutaraldehyde was generated per month and was disposed of down the drain followed by 5 minutes of running water. This disposal practice is acceptable from a regulatory perspective. However, drain disposal is not a desirable practice from a P2 perspective, which aims fundamentally at source reduction. One respiratory therapy employee was monitored to measure exposure. The cost to monitor the employee was \$35 per year. Eventually, the equipment would acquire a bad taste and would require replacement.

Current Process Operation, Waste Generation, and Costs: Respiratory therapy equipment is first soaked in an enzymatic cleaner and rinsed in water. After rinsing, the equipment is inserted into a peracetic acid-based system (the Steris machine) that requires a 12-minute exposure time at a temperature of 49°C. Each time the Steris machine is used, a box (0.24 L) of 35 percent peracetic acid in powder form is placed in the Steris machine. The sterilization cycle uses about 50 L of water. The equipment is air dried after sterilization. The process requires about 20 to 30 minutes. At the end of the process, the equipment is considered sterile. Peracetic acid leaves no unpleasant taste on the equipment. The waste peracetic acid solution is discharged directly to the sewer with other VAMC wastewater. The Steris machine is operated about 20 times per month. One case (4.71 L) of peracetic acid is used per month at a cost of \$99 per case. There is no cost for disposal. The cost to purchase the Steris machine was approximately \$16,000.

Implementation Issues: The process quality improved after glutaraldehyde substitution because no residual taste remains on the equipment. In addition, process time decreased by about 50 percent. The Steris system also eliminated both worker exposure to glutaraldehyde and the concomitant exposure monitoring. Finally, implementation of the Steris system also eliminated use of dilute acetic acid, which was formerly used as a final rinse. There were no implementation issues other than worker training.

VAMC Point of Contact: Betty Jarvis, Home Respiratory Care Coordinator, Respiratory Care Section of VAMC, (303) 399-8020 ext. 3125

TABLE 3-5

**VAMC POLLUTION PREVENTION ASSESSMENT SUMMARY:
SUBSTITUTION OF PERACETIC ACID FOR GLUTARALDEHYDE**

	Before	After	Annual Direct Cost Savings
Raw Material	Glutaraldehyde	Peracetic acid	
Annual Use	454 liters	12 cases (57 liters)	
Annual Cost	\$672 to \$1,620	\$1,188	\$<516>to \$432
Waste Generation	Waste glutaraldehyde	Waste peracetic acid solution	
Annual Quantity	454 liters	12,000 liters	
Management	Poured down the drain followed by running water for 5 minutes	Discharged directly to drain	
Disposal costs	None	None	\$0
Total Annual Direct Cost Savings			\$<516>to \$432
Indirect Benefits	<ul style="list-style-type: none"> • No capital equipment/ maintenance costs 	<ul style="list-style-type: none"> • Workers do not become sensitized to odor • Workers do not need to be monitored • 25-minute process time • Does not leave bad taste on equipment • Sterilizes equipment • Requires less frequent equipment replacement 	
Indirect Concerns	<ul style="list-style-type: none"> • Workers become sensitized to odor • Workers must be monitored • 45-minute process time • Leaves bad taste on equipment • Cleans equipment • Frequent respiratory therapy equipment replacement due to glutaraldehyde taste and wear on equipment (6 mouthpieces per year at \$3.00 per mouthpeice) • Requires workers to properly flush when disposing of glutaraldehyde down the drain 	<ul style="list-style-type: none"> • Initial investment is high - Steris machine costs \$16,000 • Less frequent respiratory therapy equipment replacement from wear on equipment (3 mouthpieces per year) 	

3.5 SOLID WASTE RECYCLING PROGRAM

Description: In 1991, a VAMC committee implemented a volunteer solid waste recycling program.

Past Process Operation, Waste Generation, and Costs: Before 1991, no recycling programs were in place at the VAMC. All solid waste was disposed of as general refuse in a landfill. The cost for disposal of general refuse was \$220 per dumpster (40 yd³). Annual expenditures prior to 1991 for general refuse were unavailable during this assessment.

Current Process Operation, Waste Generation, and Costs: A recycling program was started in 1991 by an ad hoc committee of six VAMC employees. The items and quantities listed in the table below are recycled at VAMC.

TABLE 3-6
DENVER VAMC RECYCLED MATERIALS

Recycle Waste	Annual Quantity Recycled (1996)	Recycling Firm
Office paper	114 tons	Waste Management of Colorado, Denver, CO
Cardboard	50 tons	Waste Management of Colorado, Denver, CO
Aluminum cans	26 tons	VAMC volunteers
Newspaper	300 cubic yards	Tri R Systems, Denver, Colorado
Printer ribbons	1,600 printer ribbons	Unknown at this time
Fluorescent lamps	4,000 fluorescent lamps	Environmental Information Service, Inc. Arvada, CO
Cooking oil	2.6 tons	Unknown at this time
Wooden pallets	900 wooden pallets	Ace Kauffman, Denver, CO
Rubber stamps	100 rubber stamps	Unknown at this time
Plastic bottles	7,500 plastic bottles	Sierra Club, Denver, CO
NiCad batteries	150 NiCad batteries	Rocky Mountain Battery Service, Inc., Wheatridge, CO
Telephone books	600 telephone books	Waste Management of Colorado, Denver, CO
Photographic silver	70 pounds	Federal collection program
Steel cans	2,500 steel cans	VAMC volunteers

According to the Recycling Program Coordinator, a volunteer, the program saves VAMC \$35,000 per year in disposal costs and operates on a budget of \$4,000 per year. All items are recycled locally. Only two types of recyclables, fluorescent lamps and NiCad batteries, cost VAMC money to recycle. However, these wastes would otherwise be disposed of as hazardous waste, which is costly and a less desirable option. The program won the 1996 Hammer Award and 1997 Closing the Circle Award from the White House. A copy of the 1996 Closing the Circle Award nomination is in Appendix 2. Future plans for the recycling program include glass and increased plastic recycling.

In addition to recycling, VAMC also purchases recycled material such as copy paper, toner cartridges, pens, toilet paper, and tissue paper.

Implementation Issues: One person was hired to bale the cardboard; this salary is essentially paid for by the money received for the cardboard recycling and money saved from reduced trash compactor waste. The money from the cardboard recycling is paid to the Directors Office and the Directors Office pays the person to bale. Because of recycling, \$400 per week is saved by the reduction in waste added to the trash compactor. Janitorial staff are required to do extra work to collect separated recyclable materials. There was an initial cost of \$10,000 to rent the baler for one year and purchase recycling containers. The program operates on a budget of \$4,000 per year. This money is used to pay for fluorescent lamp and NiCad battery recycling and baler rental. The baler rental fee includes maintenance costs. The initial and annual costs of the recycling program are paid by the VAMC Director's Office. Several VAMC employees have volunteered their time to keep the program running. Barriers to growth of the program include lack of outdoor storage area and limited pickup of certain items. For example, certain glass and plastic items are not recycled because the City of Denver recycling service is not available to federal facilities. VAMC does not have space to store the recyclables until they are taken to a recycling service.

VAMC Point of Contact: Dr. Arnie Schultz, Recycling Task Force Co-Chair, Clinical Chemistry Laboratory, (303) 399-8020 ext. 2625

3.6 OTHER POLLUTION PREVENTION PRACTICES

The P2 assessment team observed several other on going P2 practices or initiatives at VAMC that demonstrate commitment to P2. These include:

- A program to replace mercury-containing medical devices, such as thermometers and manometers, with nonmercury-containing replacements through attrition. For the most part, this program has been completed. Occasionally mercury-containing devices are

still found and are replaced immediately. Additional details regarding this program are unknown because the program was initiated by personnel who are no longer employed at VAMC.

- The clinical laboratory reuses spent methanol from its staining machine to clean slide holders.
- The reverse osmosis membranes in kidney dialysis machines are cleaned with a hydrogen peroxide and peracetic acid mixture instead of formaldehyde. This minimizes chemical exposure risk to employees.
- Compared to other Federal facilities in the Denver metro area, a large number (55 participants) of VAMC employees participated in the 1997 Bike to Work Day, a program to reduce pollution associated with commuting. To promote bicycle use, bicycle racks are located at main building entrances.
- Research laboratories have reusable pipette tip stands. In most VAMC research laboratories, pipette tips stands are cleaned and reused rather than being disposed of after one use.
- The paint shop uses only latex paint and has reduced its painting requirements. The Medical Center has been painted with a standardized, limited set of paint colors. Paint colors can be chosen from a color board designed by the facility's interior decorator. By standardizing the number of colors of paint available, paint is not over purchased. Overstock of paint can lead to paint expiration that requires disposal. Since one paint color has multiple uses throughout the facility, paint that is left over after one paint order it can be used on another order before it expires. Paint use and labor expenditures are also minimized by establishing that only one base color of paint be used on the main walls throughout the facility. By not changing the color of the base wall paint, touch ups require only one coat of paint instead of the two coats required when paint colors are changed.
- The VAMC has switched from using paint to adhesive vinyl tape for roadway crosswalks. They found the vinyl tape lasts twice as long as the painted crosswalks.

4.0 RECOMMENDED POLLUTION PREVENTION PROJECTS

This section analyzes three recommended P2 projects based on the site visits to VAMC. The P2 projects presented in this section received a detailed feasibility analysis which evaluated the project's impact on the use and generation of hazardous substances and its ability to reduce costs and environmental impacts and improve worker health and safety. Each of the analyses is presented in a slightly different format due to the inherent differences in the types of wastes and P2 opportunities associated with them.

Only the direct costs and savings have been provided. Indirect costs and savings related to these benefits and concerns are not presented because of the uncertainty in appraising the actual or approximate values of these costs. It is important to note, however, that indirect costs are real costs associated with these

benefits and concerns and should be considered when evaluating the pros and cons of the proposed P2 opportunity.

P2 opportunities discussed in Section 5.0 did not appear to offer a lucrative pay back period at the time of this assessment and therefore were not presented in the same level of detail as P2 options presented in Section 4.0. Technical availability, financial conditions and VAMC operating practices may change over time. The VAMC should consider periodically evaluating each option presented in Section 5.0 against feasibility criteria such as potential waste reduction, cost savings, risk reduction, and improved quality to determine if conditions have become more favorable for implementation.

4.1 INFECTIOUS WASTE REDUCTION

Infectious waste is generated in various areas throughout the VAMC complex. These areas include patient ward, operating rooms, clinical laboratories, research laboratories, and the morgue. Infectious waste is collected in red bags and sent off site for incineration and disposal. VAMC generates about 85 tons of infectious waste per year at a treatment and disposal cost of \$49,500. At the time of the September 1997 P2 assessment, VAMC was in the initial stages of establishing a committee to address infectious waste reduction. Creating such a committee is an important first step to developing a successful infectious waste reduction program. This section describes observations on infectious waste generation at VAMC, outlines an approach to developing an infectious waste reduction program, presents successful infectious waste reduction activities, and estimates cost savings from potential infectious waste reductions.

4.1.1 Infectious Waste Generation at VAMC

The Denver VAMC must adhere to waste definitions and protocols included in various state and federal statutes, regulations, and guidelines including:

- Medical Waste Tracking Act of 1988
- Centers for Disease Control (CDC) and Occupational Safety and Health Administration universal precautions for bloodborne pathogens
- State of Colorado House Bill 89-1328, which is based on EPA's 1986 "Guide for Infectious Waste Management"

Infectious waste is defined as “waste capable of producing an infectious disease.” For a waste to be classified as infectious, it must contain a pathogen of sufficient virulence, dose, portal of entry and resistance of the host to induce a disease. Categories of waste that meet such criteria include:

- Isolation wastes from persons diagnosed as having a disease caused by an organism requiring CDC biosafety level IV containment
- Cultures and stocks of infectious agents and associated biologicals
- Human blood, blood products, and body fluids
- Human pathological and anatomical wastes
- Contaminated sharp instruments (“sharps”)
- Contaminated laboratory and research wastes including contaminated animal carcasses, body parts, and bedding

Under current regulations, it is not always easy to determine what constitutes infectious waste. In order to promote worker safety, adhere to stringent regulations, minimize liability, and maintain a positive public image with regard to infectious waste management, VAMC, like many health care organizations, may be conservative in identifying its infectious waste. According to the Minnesota Hospital Association Public Affairs Division, some hospitals routinely dispose of 30 to 45 percent of their total waste stream as “red bag,” or infectious waste. An article from the April 1990 *Pollution Engineering*, “Hospital Waste Management,” estimated that 85 percent of the overall hospital waste stream can be categorized as general refuse, while the remaining 15 percent can be categorized as infectious waste. These estimates suggest that a 50 to 67 percent infectious waste reduction is possible. The percent of VAMC’s total waste stream attributed to infectious waste could not be determined from the information collected during the P2 assessment.

During the VAMC P2 assessment, visual inspections and staff interviews were conducted to gauge the potential for infectious waste reduction. During visual inspection of red bag containers, the assessment team noted the presence of product packaging and disposable containers apparently un-associated with infectious waste. However, visual inspection alone is inadequate to determine if a waste item is classified as infectious. The placement of questionable waste items in infectious waste containers should be considered on a case-by-case basis. The history of each waste item’s exposure to potential pathogens should be tracked to determine the appropriate waste category (infectious or solid) for the item. A comprehensive audit of this nature was not conducted under the scope of this P2 assessment.

Interviews with VAMC laboratory and research staff suggest that the definition of infectious waste and how it applies to wastes generated from their department is not always clear. Consequently, wastes of “uncertain status” are often conservatively disposed of as infectious waste. For example, one laboratory considers items such as protective gloves to be infectious waste (even if the gloves had not come into contact with potential infectious sources) in order to minimize questions during regulatory inspections.

VAMC departments that generate infectious waste are not responsible for paying for infectious waste management costs from their separate operating budgets. Instead, waste management costs are covered by a facility-wide, waste management budget. This practice reduces departmental incentives for waste reduction because each department is not accountable for its waste management costs. Moreover, VAMC does not track infectious waste generation and associated costs for each department source. Without a tracking system in place, the department or processes with the largest potential for infectious waste reduction is difficult to identify.

VAMC should establish a comprehensive infectious waste reduction program to (1) determine the areas and sources with the greatest potential or cost incentive for reduction and (2) identify and implement P2 opportunities to reduce infectious waste generation. The following section provides an approach for implementing such a program.

4.1.2 Establishing an Infectious Waste Reduction Program at VAMC

An infectious waste reduction program should be established to create an environment that is conducive to identifying and successfully implementing P2 opportunities. There is no one solution to reduce infectious waste generation at VAMC because infectious waste is generated by hundreds of different operations and activities within several different departments. Infectious waste reduction must be pursued in a programmatic manner that involves worker training and focused source reduction efforts on high-volume sources of infectious waste. A variety of P2 approaches should be explored. P2 approaches involve material substitution, equipment changes, process modifications, material handling improvements, and waste segregation.

The infectious waste reduction program at VAMC should include the following components:

- An infectious waste reduction committee (this component has already been initiated at VAMC)

- An infectious waste generation tracking system
- An employee training program
- Periodic assessments of infectious waste generating activities to identify source reduction opportunities
- A review panel whose purpose is to (1) review infectious waste reduction opportunities with respect to regulatory compliance, health and safety, payback period, and quality and (2) ensure that feasible opportunities are implemented.

The infectious waste reduction committee should establish a specific approach and timeline for implementing the infectious waste reduction program. The committee should include representatives from each department that generates infectious waste, as well as staff from nursing, environmental services, purchasing, risk management, and senior management.

Before infectious waste reduction opportunities are implemented, a baseline of infectious waste generation should be established. Then, as infectious waste opportunities are put into place, the resulting waste reduction should be tracked to assess the percent infectious waste reduction. This infectious waste tracking system can also be used to determine which areas of VAMC have the largest potential for infectious waste reduction and the specific processes that generate infectious waste.

One approach to establishing a tracking system would be to (1) assign each infectious waste collection receptacle a number and note which department contributes to it; (2) conduct a 1-week infectious waste survey, recording the weight, not volume, of red bag waste collected from each receptacle; (3) on a periodic basis (for example, every 3 months), repeat the 1-week survey to track changes in generation rates. Environmental service or housekeeping staff that collect infectious waste on a daily basis would be good candidates for this task. During the survey, the staff should use a scale to weigh each red bag and a log to record data after each receptacle is picked up.

The distribution of infectious waste according to various categories (for example, product packaging, disposable equipment, absorbent pads, petri dishes, protective gloves, and sharps) is also important information to collect in the infectious waste survey. Each department that generates infectious waste should list the types of materials that are placed into the corresponding red bag receptacles. This task should be conducted by department members since they are most familiar with the composition of their red bag waste.

Waste types can be recorded in a quantitative or qualitative manner. To collect quantitative information, VAMC staff, in appropriate protective gear, should sort through the waste, and separate, weigh, and record each waste category. To collect qualitative information VAMC staff should record waste component types using visual observation. However, since the waste types are not weighed, statistics will not be available to determine the percent, by weight, of each waste type in the red bag. For both qualitative and quantitative data collection methods, VAMC department personnel should record tasks generating each infectious waste type and the reason the material was considered an infectious waste. Infectious waste characterization is an essential first step toward identifying and implementing source reduction techniques.

All staff involved in activities that generate infectious waste should receive training that clarifies the regulatory definitions of infectious waste and how the definitions apply to wastes generated in their department. In addition, existing policies and SOPs should be reevaluated. If a policy or SOP is more stringent than the regulations, the basis for its stringency should be determined and the impact of overly conservative approaches on infectious waste quantities should be evaluated. Staff should be encouraged to identify source reduction opportunities and optimize segregation of non-infectious waste from infectious waste.

There are several benefits that result when segregation and source reduction methods are applied to processes that generate infectious waste. The environmental benefit of separating infectious waste and non-infectious waste derives from less waste that requires energy-intensive incineration for treatment. In addition, by reducing the quantity of non-infectious waste disposed of as infectious waste, release of hazardous constituents (for example, heavy metals) through incinerator emissions or ash can also be reduced. The cost benefit is associated with reduced treatment and disposal costs.

However, if segregation is implemented without source reduction, the total volume of waste (including infectious waste, solid waste and recyclables) generated by VAMC will not be reduced. In other words, segregation prevents solid waste and recyclables from becoming infectious waste but does not reduce the overall waste stream. The reduction in infectious waste is countered by a similar gain in solid waste and recyclables generated.

Source reduction, unlike segregation, reduces the overall volume of waste generated. Source reduction examples that minimize infectious waste generation include:

- Switching from disposable infectious waste containers to reusable containers

- Switching to a reusable sharps collection system
- Switching to reusable surgery masks, gowns, caps, and drapes
- Purchasing products that come in reduced amounts of packaging
- Improving staff training and equipment quality to prevent mistakes that involve repeating procedures that generate infectious waste

Source reduction results in benefits similar to those achieved from waste segregation, including reduced treatment and disposal costs, energy conservation from reduced infectious waste requiring treatment, and reduced incineration emissions. Additionally, source reduction decreases costs associated with purchasing disposable products such as waste containers, surgery garments, and surgery drapes.

When an infectious waste reduction opportunity is identified, the VAMC infectious waste reduction committee should evaluate the feasibility of the P2 opportunity, comparing it against criteria for regulatory compliance, health and safety, payback period, and quality.

Finally, each step toward infectious waste reduction should be considered in a prudent manner, to avoid liability associated with potential infectious waste mismanagement. Program successes help promote additional accomplishments and imbue the program with the momentum necessary to achieve its goals. In turn, one violation of infectious waste regulations can create program inertia that is difficult to overcome.

4.1.3 Successful Infectious Waste Reduction

The following are four examples of infectious waste reduction from the "Waste Not Book" by the Minnesota Hospital Associations Public Affairs Division and three examples from the Beth Israel Medical Center Complex:

- Proper segregation helped the Minneapolis VAMC reduce infectious waste by 50 percent over a 6-month period. Through efforts of the environmental management services working in concert with surgery services and the operating room nurses, two regular waste containers and one red bag container were placed in each surgical unit, rather than two red bag containers and one regular container. All wrappings prior to surgery are automatically deposited into the municipal solid waste container. In addition, the hospital previously had red bagged all waste after the incision was made. Now the nurses consider placement of each item before disposing. All glass and plastic from the operating room is recycled. The volume of infectious waste has been reduced from 32,000 to 17,000 pounds per month. (Contact - Evan Smith, Assistant Chief, VAMC, Minneapolis).

- Reusable infectious waste containers replaced disposable containers at Community Hospital in Cannon Falls and Methodist Hospital in St. Louis Park, among others. In addition, many hospitals now use reusable sharps containers. (Contact - Judy Paprock Brenner, Public Relations, Methodist Hospital, St Louis Park)
- Reusable surgical gowns replaced disposable gowns in many hospitals, including Weiner Memorial Medical Center in Marshall, Minnesota. Weiner Memorial is projecting a savings between \$1.50 to \$2.00 per use.
- St. Joseph's Medical Center in Brainerd, Minnesota, switched to reusable isolation gowns. The hospital eliminated purchases of 1,500 gowns each year. In Coon Rapids, Minnesota, Health One Mercy Hospital found that it costs \$0.87 for a disposable isolation gown compared to \$0.20 per use for a reusable gown.
- At the Beth Israel Medical Center in Manhattan, New York, red bag waste has been reduced by at least 1 million pounds per year, and associated waste hauling fees reduced by more than \$600,000 per year through improved segregation, reuse, and recycling, and changing the types of products purchased and work practices.
- Beth Israel's North Division saved \$175,000 per year in red bag waste disposal through improved segregation, reuse, and product and process changes. Switching to reusable sharps containers and improved recycling also contributed to the cost savings. (Contact - Janet Brown, Waste Manager, Beth Israel Medical Center, (212) 420-2442 or jbrown@bethisraelny.org)
- The Beth Israel's Kings Highway Division implemented an improved waste management program in August of 1996. As a result, the waste budget of \$300,000 per year was cut in half. The program included reducing red bag waste by two thirds through improved segregation effort by staff members, renegotiating an overpriced waste contract, switching to a reusable sharps collection system, and implementing office paper recycling. (Contact - Janet Brown, Waste Manager, Beth Israel Medical Center, (212) 420-2442 or jbrown@bethisraelny.org)

4.1.4 Potential Cost Savings from Infectious Waste Reduction

The percentage of direct cost savings that can be realized from reducing infectious waste generation is proportional to the percentage of infectious waste reduction achieved. VAMC generates about 85 tons of infectious waste per year at a treatment and disposal cost of \$49,500. According to estimates presented in Section 4.1.1, it may be feasible for VAMC to realize an infectious waste reduction of up to 50 to 67 percent, which equates to a potential direct cost savings of up to about \$33,000. Direct cost savings from reduced treatment and disposal will be offset by the administrative cost to implement the infectious waste reduction program. Table 4-1 presents the direct cost savings associated with various percent reductions in infectious waste amounts.

TABLE 4-1
ANTICIPATED COST SAVINGS AND WASTE REDUCTION BY PERCENT

Infectious Waste Reduction (%)¹	Annual Infectious Waste Reduction (tons)	Annual Cost Savings²	Annual Infectious Waste Generation (tons)	Annual Costs²
0	0.0	\$0	85.2	\$49,503
5	4.3	\$2,475	81.0	\$47,028
10	8.5	\$4,950	76.7	\$44,552
15	12.8	\$7,425	72.5	\$42,077
20	17.0	\$9,901	68.2	\$39,602
25	21.3	\$12,376	63.9	\$37,127
30	25.6	\$14,851	59.7	\$34,652
35	29.8	\$17,326	55.4	\$32,177
40	34.1	\$19,801	51.1	\$29,702
45	38.4	\$22,276	46.9	\$27,226
50	42.6	\$24,751	42.6	\$24,751
55	46.9	\$27,226	38.4	\$22,276
60	51.1	\$29,702	34.1	\$19,801
65	55.4	\$32,177	29.8	\$17,326
67	57.1	\$33,167	28.1	\$16,336

Notes:

- 1 For illustrative purposes, this table assumes that VAMC is disposing of 45% of their total waste stream as red bag waste and that only 15 percent of the total waste stream is actually considered infectious waste. These numbers could not be verified during the VAMC P2 assessment since a comprehensive infectious waste survey was not conducted.
- 2 Costs include those associated with offsite treatment and disposal, but exclude labor costs to collect red bags inside the VAMC complex. The average cost per ton (\$581/ton) was determined using invoices for infectious waste treatment and disposal from the 1997 fiscal year at VAMC.

4.2 FORMALIN REPLACEMENT

The VAMC histology laboratory and morgue use formalin as a tissue and organ sample fixative. Formalin is a semi-aqueous solution containing 37 to 40 percent formaldehyde and about 10 percent methanol. Formalin is a preferred fixative because it destroys bacteria, fungi, molds, and yeast; has a long history of use; and maintains a natural pink color in the specimens. Formalin is particularly important as a brain fixative because it not only preserves it from decay, but it also causes the brain tissue to become firmer, thus more manageable without causing deformation.

Formalin is considered a hazardous material because of its formaldehyde and methanol content. Workers using formalin must be monitored for formaldehyde exposure. Formalin is highly irritating to the upper respiratory tract and eyes. Further, prolonged or repeated exposure may result in respiratory impairment. It is also a severe skin irritant and a sensitizer. The perception of formaldehyde by odor and eye irritation becomes less sensitive with time as one adapts to formaldehyde. This can lead to overexposure if a worker is relying on formaldehyde's warning properties to alert him or her to the potential for exposure. A person sensitized to formaldehyde is often required to change job functions to eliminate further formaldehyde exposure. In a study cited by the Occupational Health and Safety Administration's preamble to the Formaldehyde Standard, 79 percent of histotechnologists suffered from formaldehyde-related respiratory symptoms, dermatitis, or both. Formaldehyde has the potential to cause cancer in humans. Repeated and prolonged exposure increases the risk. In humans, formaldehyde exposure has been associated with cancers of the lung, nasopharynx and oropharynx, and nasal passages. Therefore, due to these health and safety issues, formalin replacement is a high P2 priority. Further, VA P2 Strategy directs VA facilities to reduce toxic or hazardous substances. The VA P2 strategy is included in Appendix 3. This section describes formalin use and disposal at VAMC, presents three less toxic formalin replacements, outlines an approach to an on-site formalin replacement feasibility study, and compares the costs of formalin and formalin replacements.

4.2.1 Formalin Use and Disposal at VAMC

The histology laboratory and morgue use about 100 L of formalin per month for tissue and organ sample preservation. Tissue samples are stored in 15 to 180 mL biopsy containers prepackaged with a 10 percent formalin solution. Organ samples are stored in closed 5-gallon buckets that contain 1 to 2 gallons of 10 percent formalin solution. Samples are typically stored on site for about 6 months.

When tissue and organ samples are disposed of at VAMC, waste formalin is flushed down the drain with running water. This disposal practice is acceptable from a regulatory perspective because the waste formalin does not exhibit hazardous waste characteristics and the Denver Metro does not prohibit waste formalin in the sanitary sewer system. However, drain disposal is not a desirable practice from a P2 perspective, which aims fundamentally at source reduction. Laboratory personnel estimated the waste formalin generation rate is 18.25 L per month from tissue samples and 57 to 114 L from organ samples every 3 months.

4.2.2 Replacement Options

Three less toxic formalin replacements are commercially available and promoted as direct replacements for formalin; these replacements are listed in Table 4-2.

TABLE 4-2
VAMC POLLUTION PREVENTION ASSESSMENT
FORMALIN REPLACEMENTS

Product Name	Manufacturer	Description
<i>Prefer</i>	Anatech Ltd. 1-800-ANATECH	glyoxal (two-carbon di-aldehyde) in a solution of ethanol, water, and non-toxic buffer
OmniFix 2000	Aaron Medical Industries, Inc. 1-800-537-2790	solution of alcohols and water with non-toxic buffer
SafeFix II	Biochemical Sciences, Inc. 1-800-524-0294	non-toxic aldehydic compound with alcohol

Formalin replacement manufacturers have tested the products using a variety of methods to compare the performance to formalin. For example, Biochemical Sciences, Inc. used Safe Fix II in several hematoxylin and eosin (H&E) and special stains and compared the results to those obtained using formalin. Similarly, large organs were placed in SafeFix II to compare its fixing ability to formalin. Anatech Ltd. set up a series of two clinical laboratory experiments. The first involved sending 10 tissue samples to 12 pathologists at 10 to 12 hospitals. The samples were labeled control (formalin fixed) or experiment (*Prefer* fixed). Portions of the same tissue were placed in each of the fixatives and the facilities were asked to stain the samples in any manner they preferred and rate the experimental versus control fixed tissues. The second stage of the clinical trial was to send samples of the replacement to technicians at six facilities and ask for responses related to the performance of the formalin replacement. Each of the experiments yielded positive results about the formalin replacements. In general, formalin replacements perform as well as formalin with respect to preventing the growth of bacteria, fungi, molds, and yeast. However, the natural pink color of the specimens is not maintained as well with formalin. This appears to be a cultural barrier and not a quality issue. According to various studies, visual clarity of the tissues fixed with formalin replacements can be comparable to formalin fixed tissues. Tissues fixed with formalin replacements do not tend to be as firm as tissues fixed with formalin. VAMC should evaluate the formalin replacements to determine if they meet their tissue firmness requirements.

Using formalin replacements sometimes requires changes in laboratory procedures. A common difference experienced using formalin replacements is tissues stain too dark to view. This difference is easily corrected by modifying staining procedures to decrease the staining time when using a formalin replacement.

In 1997, VAMC histology laboratory personnel informally evaluated the effectiveness of SafeFix (the predecessor of SafeFix II) as a formalin replacement using free samples obtained from the manufacturer. During this informal evaluation, tissue samples were randomly placed in SafeFix without informing pathology staff of the substitution. About 6 months after SafeFix was introduced, the pathology staff were informed of the substitution and told which samples were preserved in formalin and SafeFix. No

complaints regarding sample quality were received until 1 month after the pathology staff was informed of the substitution. The complaint concerned difficulty in viewing nuclear characteristics of a melanoma specimen fixed in the formalin replacement. According to VAMC personnel, this complaint was not related to the length of staining time. After receiving this complaint, the histology laboratory stopped using SafeFix. Because there were few complaints about SafeFix and because the single complaint pertained to specific specimen types, VAMC should continue its evaluation of formalin substitutes. Further evaluations should consider the three products identified in Table 4-2.

VAMC should consider a more formal evaluation process for formalin replacement. For example, VAMC could stain duplicate samples in formalin and one or more in formalin replacements. Pathologists could then view each of the samples, one in formalin and the others in a formalin replacement. This approach would help VAMC identify the best formalin replacement and, more importantly, specimen types not amenable to nonformalin fixation. A structured evaluation would also help assess different staining procedures necessary when using the replacements. Representatives from all VAMC departments affected should be involved in the formalin replacement evaluation process to ensure all viewpoints and potential barriers to replacement are considered before final decisions are made.

4.2.3 Formalin Recycling

If total elimination of formalin use is not possible, VAMC should consider formalin recycling. Recycling formalin will reduce the amount of waste generated at VAMC and reduce formalin purchasing costs. B/R Instrument Corporation (B/R) manufactures a formalin recycling system. B/R calculated a payback period analysis of the system for VAMC. This analysis is included in Appendix 4.

4.2.4 Formalin and Formalin Replacement Costs

VAMC purchases formalin in small, prefilled tissue biopsy containers and in bulk form for organ samples. Examples of formalin products and costs regularly purchased by VAMC are shown on Table 4-3.

TABLE 4-3
FORMALIN PURCHASING COSTS

Product	Total Formalin Volume	Cost
200 X 10 mL prefilled Formalin	2.00 L	\$130.00
48 X 15 mL prefilled Formalin	0.720 L	\$33.00
24 X 60 mL prefilled Formalin	1.44 L	\$31.00
4 L (1 gallon) Formalin	4 L	\$19.00
19 L (5 gallons) Formalin	19 L	\$48.00

Formalin use also incurs monitoring costs for employee exposure. At least 25 percent (usually about 8 people) of the workers who come in contact with formalin are monitored for a 15-minute exposure and an 8-hour exposure once per year. Each badge costs \$35 per year to purchase and analyze. VAMC staff time to oversee formalin monitoring is about 4 hours per year. According to VAMC personnel, no significant costs such as time spent report writing or reviewing are related to monitoring costs.

It is possible to find replacements less expensive than formalin. Table 4-4 compares the costs of formalin to an alternative fixative.

TABLE 4-4
COST COMPARISON OF FORMALIN VERSUS A FORMALIN REPLACEMENT

Quantity	Formalin Cost	Prefer Cost	OmniFix 2000® Cost	SafeFix II Cost	Total Annual Direct Cost Savings*
144 X 60 mL prefill	\$186.00	\$105.50	NA	NA	\$2,795.24
1 gallon	\$19.00	\$20	\$18.50	\$34.46	\$<158.50>
20 gallons	\$192.00	\$221.60	\$250	\$382.28	\$<229.68>
Total Annual Direct Cost Savings					\$2,407.06

*Note: Annual use based on monthly use of 100 L with the assumption that 25 percent of the quantity is purchased in prefilled containers, 50 percent in 1 gallon containers and 25 percent in 20 gallon increments. In cases where formalin replacement costs varied, the middle cost value (*Prefer*) was used for cost comparison.

Other indirect costs associated with formalin use may include:

- Worker exposure monitoring and tracking costs
- Staff down time
- Compensation claims
- Medical expenses for illness
- Annual exams for individuals who become sensitized
- Reduced odor and improved working conditions

Indirect costs related to formalin replacement are not presented because of the uncertainty in appraising the actual or approximate values of these costs. It is important to note, however, that indirect costs are real costs and should be considered when evaluating the advantages and disadvantages of formalin replacement.

4.3 CLEANING SOLVENT REPLACEMENT

The VAMC facility maintenance metal shop operates a solvent-based parts cleaning unit to clean miscellaneous machinery parts associated with repair and maintenance. The parts cleaning unit uses a petroleum distillate solvent that is managed as a hazardous chemical. The cleaning unit is operated by

placing the part to be cleaned in a sink-like basin mounted above a 20-gallon solvent reservoir container. The part is cleaned by spraying and brushing with solvent. Oils and grease are dissolved and removed from the part in the solvent. Solvent drains back into the reservoir. The 20-gallon reservoir contains 12.5-gallons of solvent floating on a small volume of water. Inorganic particles and soil settle out of the solvent into the water at the bottom of the drum and solvent is reused. Fresh solvent is periodically added to make up for evaporative losses. VAMC uses about 19 gallons of solvent per year. In addition, solvent in the reservoir eventually becomes spent due to an excess of dissolved oil and grease. The solvent is disposed approximately once per year.

VAMC should consider replacing the solvent parts cleaner with a water-based (aqueous) cleaning unit. Aqueous systems are beneficial because they promote healthier working conditions, reduce paper work, and reduce environmental risk associated with storing and moving hazardous chemicals. This section describes sink-top aqueous cleaning units, discusses implementation issues associated with aqueous cleaning, and provides information about sink-top aqueous cleaning unit vendors.

4.3.1 Sink-top Aqueous Cleaning Units

Sink-top units are designed for manual cleaning of parts. Parts are loaded into the sink-like basin and cleaning solution is applied by a faucet, spray, or flow-through brush. The sink area is generally about 2 feet wide by 3 feet long and 1 foot deep. Used solution flows down through a drain, is stored in a container below the sink top, and is recirculated back to the faucet or brush by a small pump. The cleaning solution is typically heated to between 105 and 110°F. Cleaning occurs primarily through manual scrubbing. Special features on some sink-top cleaning units include particulate filters and oil removal devices. Some sink top units also use microbes to biodegrade organic impurities such as oil and grease. Microbes are introduced into the solution either through a filter media or biological chamber. These units can significantly extend solution life and reduce spent solution generation. Many manufacturers claim that cleaning solutions with microbes never become spent and only need additional solution to be added.

4.3.2 Implementation Issues

Replacing traditional solvent parts cleaners with aqueous units presents several issues that must be resolved for successful implementation. The foremost issue typically concerns the possibility of oxidation (rust) on metal surfaces after contact with aqueous cleaning solutions. Most cleaning unit vendors address this by adding a rust inhibitor to the aqueous cleaner. The concentration of rust inhibitor depends on application-specific conditions. Another strategy for preventing surface oxidation involves the use of compressed air to quickly dry parts immediately after cleaning. Manual application of compressed air is usually feasible in maintenance shops where use of the cleaning unit is intermittent. In cases where the cleaning unit is used continuously, manual application of compressed air to dry part

surfaces may not be practical due to reduced throughput caused by introducing a drying step. Rust inhibitors and compressed air are often combined to resolve the oxidation issue; however, on-site testing is needed to establish preferred operating conditions. Many manufacturers suggest coating the parts after cleaning to prohibit rust formation.

Aqueous cleaning units may generate spent cleaning solution, and the management and disposal requirements for spent aqueous cleaning solution should be considered before implementation. Biodegradation-type system manufacturers claim that no wastewater is generated because the microbes eliminate all contaminants. Many systems include filters that must be disposed of regularly. Manufacturers claim all filters can usually be disposed of as general refuse. The disposal method depends, however, on the contaminants on the parts being cleaned. The aqueous parts cleaner should be used to remove nonhazardous contaminants, such as grease and soil, from parts. If hazardous chemicals, such as trichloroethane, are put in the parts cleaning unit, it could cause the cleaning solution to be considered a hazardous waste.

Another implementation issue associated with solvent substitution is worker skepticism about the effectiveness of the aqueous cleaning unit. This issue is potentially “project stopping” and should be overcome by working with cleaning unit vendors to demonstrate the ability of aqueous units to provide comparable cleaning. Many vendors offer free on-site demonstrations or will rent units for a trial period. Table 4-5 summarizes information about seven sink-top cleaning units and their vendors. In some cases, vendors provided reference names of companies that are presently using their parts cleaning system. VAMC should use this information to contact vendors and arrange for on-site testing and demonstrations. Most small maintenance operations, such as VAMC’s metal shop, require about 3 months to collect sufficient information about available sink-top aqueous cleaning units to make a final selection.

4.3.3 Solvent Substitution Costs and Benefits

Estimated costs and benefits associated with solvent substitution are summarized in Table 4-6. Although a direct cost savings is not realized, indirect benefits should justify purchasing an aqueous cleaning unit.

5.0 OTHER POLLUTION PREVENTION OPPORTUNITIES

Other P2 opportunities were observed during the VAMC assessment in addition to those discussed in Section 4.0. The following list briefly explains other P2 opportunities at VAMC.

- **Water:** Decrease water use by installing flow restrictors on flush valve toilets, replacing tank toilets with low-volume toilets, installing faucet aerators on all sink faucets, and eliminating and replacing all once-through cooling units. These suggestions derive from a 1991 Denver Water Department Nonresidential Water Audit. Questions related to

water use may be directed to Eddie Hernandez of the Denver Water Department at (303) 628-6563.

- **Wastewater:** VAMC is currently discharging wastewater containing spent chemicals to Denver Metro. While VAMC appears to be in compliance with all applicable regulations, a source reduction approach would take water management a step further. Using source reduction to prevent chemicals from entering the wastewater is the management approach of choice. Chemicals that end up in a waste stream are essentially wasted raw materials. For example, formalin and methanol are both chemicals that may be reused following distillation. Consider collecting these chemicals for distillation instead of disposing down the drain.
- **Glutaraldehyde:** Reduce glutaraldehyde use by replacing equipment in ear, nose, and throat, and gastrointestinal laboratories with peracetic acid-based equipment (for example, Steris).
- **Methanol:** The clinical laboratory generates 20 L of waste methanol per month; waste methanol could be recycled using a simple distillation apparatus. Currently, waste methanol is disposed of down the drain.
- **Ethylene oxide:** Replace ethylene oxide sterilization with other sterilization systems such as peracetic acid system, hydrogen peroxide gas plasma system, peracetic acid plasma system, or ozone-based systems. Ethylene oxide should be removed of because it is an EPA classified probable human carcinogen, smog forming agent, and explosion/flammability hazard. Complete elimination of ethylene oxide is an attainable goal: Children's Hospital in Denver has eliminated this sterilizer (Contact: Robin Koons, Manager of Environmental Health and Safety, (303) 861-6335).
- **Expired or unused laboratory chemicals:** Develop a central purchasing and distribution system for laboratory chemical procurement. This system would ensure that chemicals are not over ordered and that laboratories have access to the exact amount of necessary chemical without having to purchase excessive quantities. In addition, the system would minimize the quantity of expired chemicals on the premises and reduce hazardous waste tracking, management and disposal costs. This opportunity may be difficult to implement due to space limitations and laboratory culture (sharing of chemicals is not always desirable because of concerns about possible chemical cross contamination). While these concerns are valid, they may be taken into consideration and addressed in development of the system. Furthermore, the VA P2 strategy directs VA facilities to implement acquisition and procurement policies that promote pollution prevention. Implementation of a central purchasing and distribution would achieve this goal. The VA Pollution Prevention Strategy is included in Appendix 3.
- **Hazardous waste tracking system:** Develop a standardized system to track hazardous waste management. This tracking system would provide data to support trends in hazardous waste generation, so that priorities and decisions could more easily be made to help focus pollution prevention efforts. The tracking system should contain the following types of information: (1) name of hazardous waste, (2) hazardous constituents of the waste, (3) volume of the waste, (4) source of the waste (area name and room number), (5) reason that the material became a waste, (6) VAMC contact familiar with the generation of the waste, and (7) date the waste was generated.
- **Latex Paint:** Close the recycling loop by purchasing consolidated and reprocessed paint outlined under the Comprehensive Procurement Guidelines.
- **Boiun's Solution:** Boiun's solution is used in the histology staining machine and contains formaldehyde and picric acid. Consider using an alternative to Boiun's Solution which uses acetic acid instead.

TABLE 4-5
SINK-TOP AQUEOUS CLEANING UNITS AND VENDORS

Supplier	Contact	Equipment Name (GSA National Stock Number)	Equipment Size	Special Features			Solution Name (GSA National Stock Number)	Pricing	
				Oil Skimmer	Filtration	Bio-Remediation		Purchase	Long-Term Lease
4U Products/Metalube Corporation	Lil Goehring (909) 279-9181	4U Kleer-flo Sink-Tops A-35	20 gallons	✓	✓		4U Multi-Purpose Cleaner Degreaser MC-509	Starts at \$1,495	✓
Batavia Technical Solutions, Inc.	Jimmy S. Varisco (800) 231-6374	PW 2000 BTS Aqueous Parts Washer System	35 gallons			✓	BTS PC Parts Cleaner	\$1,195	✓
ChemFree Corporation www.chemfree.com	Melissa (770) 564-5589	SMARTWASHER	25 gallons		✓	✓	Ozzy Juices SW2 (6850-01-454-1310)	\$1,500	✓
Graymills Corporation	Don Kuehnert (626) 331-5334	Bio 436	25 gallons		✓	✓	Biotene	\$1,395	
Hydro-Tech Environmental Systems	Aron M. LaVanter (707) 586-8390	Zymo Parts Washer (4940-01-439-7936)	15 gallons			✓	Bio-Concentrate (4940-01-439-7993)	\$1,550	✓
Nature's Way Eco-Systems, Inc. www.ecoclean.com	Jim Andrews (510) 797-4050	ES20 Bio-remediating Aqueous Parts Washer (GS-07F-9834-H)	21 to 22 gallons		✓	✓	Nature's Way Parts Cleaning Solution	\$1,295	
Inland Technology	Joe Lucas (253) 922-8932	IT33	30 gallons		✓		LA1171	\$800	✓

TABLE 4-5 (Continued)
SINK-TOP AQUEOUS CLEANING UNITS AND VENDORS

Supplier	Free On-site Demonstration	Denver Area Representative	Service	References	Notes
4U Products/Metalube Corporation		Byran Goehring Corona, CA (909) 279-9181	4U does not provide services. Client must request service from manufacturer	PB Fasteners; S.M.U.D.; Nelson Irrigation; S.P.S. Technologies; Monogram Aerospace; Hi-Shear Corp; Air Exhaust; Textron Industries; Web Industries	Options for reusing solution: (1) oil skimmer plus filter plus solution recycler, or (2) MEMBREX closed loop system.
Batavia Technical Solutions, Inc.		Jimmy S. Varisco Seabrook, TX (800) 231-6374	Fully serviced and maintained by BTS representative	Anderson-Behel Imports, San Jose, CA; DSL Transportation, Southgate, CA; Villa Honda, Hemet, CA	Microbes present in cleaning solution that degrade oil and grease. New microbes can be added and solution regenerated if microbes are killed from addition of inappropriate materials
ChemFree Corporation www.chemfree.com	✓	Bowman Distribution Kelly Fitzpatrick Denver, CO (303) 528-9700	Technical support on-site and over the phone is an option	City of Tallahassee (Bowman Dist. Rep. Arian Dixon), Abbott Labs, Inc (Denise Bauer 847-937-6825), Miller Brewing (Danielle Absell 513-844-4238), Herff Jones (Mike Rogers 334-288-5260)	Claims no wastewater generated from system. Filtration pad is impregnated with microbes that biodegrade oil and grease. User replaces filtration pad every 4 weeks
Graymills Corporation	✓	Gary Bax Denver, CO (303) 466-2268	Units are virtually maintenance free with ChemFree bioremediation solution	No references, system is new	Filter collects larger particles and must be changed approximately once every month. Solution never needs to be disposed of, only topped off as necessary
Hydro-Tech Environmental Systems	✓	Aron M. LaVanter (707) 586-8390	Service is generally not required and customer is responsible for waste disposal	National Park Service; Korbel Winery; San Jose Mercury News	Filtering system releases microbes into the fluid to degrade oil and grease. Filter replaced every 2 to 4 weeks. Fluid replaced every 18 to 24 months.
Nature's Way Eco-Systems, Inc. www.ecoclean.com		Jim Andrews Fremont, CA (510) 797-4050	\$50 every 1 to 2 months. Includes filtration of parts cleaning (PC) fluid, system check, surface cleaning, adding PC fluid, adding nutrients, and replacing filter	American Airlines (contact Kate Caldwell @ 415-877-6026), Kelley-Moore Paint, U.S. Air Force, U.S. Postal Service - Northeast Areas	Microbes retained in reservoir, or "biochamber," in the bottom of the sink-top unit. Favorable demonstration by Air Force.
Inland Technology	✓	Joe Lucas (253) 922-8932		San Diego Gas and Electric	System is new and not yet fully tested by Inland. Inland will provide solution and filters for free while in the trial stage of the system. Facility should provide feedback to Inland.

TABLE 4-6
VAMC POLLUTION PREVENTION ASSESSMENT
SOLVENT SUBSTITUTION

Cost and Benefit Considerations	Solvent Cleaning (per year)	Aqueous Cleaning (per year)	Annual Savings
Cleaning Chemical Use	19 gallons	35 gallons	
Waste Generation	15 gallons	12 filters	
Cleaning Chemical and Filter Purchase Costs	\$230	\$600*	\$<370>
Waste Disposal Cost	\$250	negligible	\$250
O&M ^b Costs	comparable		
Total direct cost annual savings =			\$<120>
Worker Adaptation	VAMC maintenance staff are familiar with solvent cleaning and will require training and demonstration before they accept the new equipment		Cost (NQ)
Material Management	Healthier working conditions from eliminated potential solvent exposure during parts cleaning		Benefit (NQ)
Solvent Emissions	Reduced environmental risk associated with storing and moving hazardous material and waste		Benefit (NQ)
Waste Management	Reduced paperwork burden associated with manifesting spent solvent as a hazardous waste		Benefit (NQ)
Assume aqueous cleaning unit capital cost =			\$1,500*

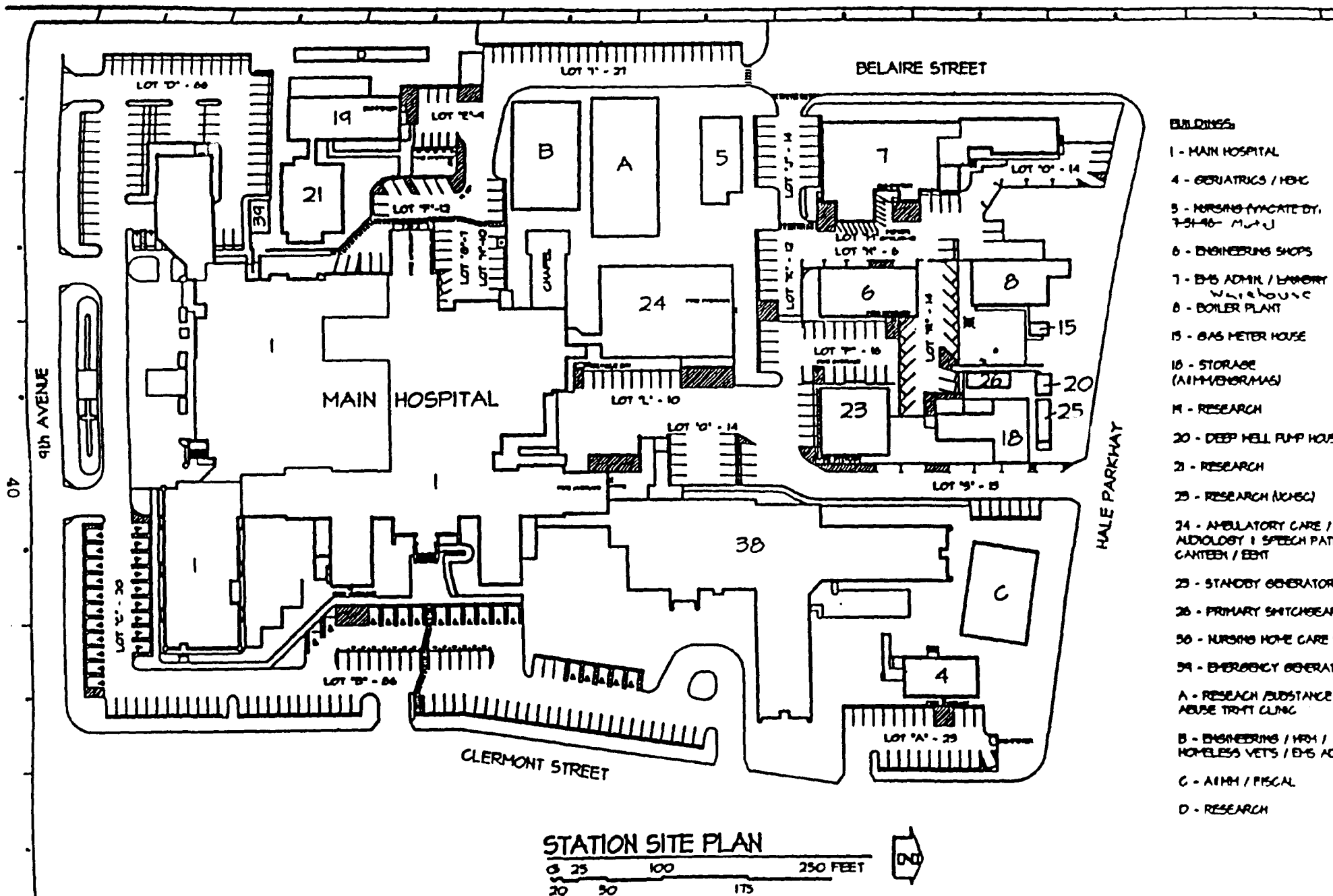
Notes:

- a Average values obtained from vendors
- b O&M = operation and maintenance
- c NQ = not quantified

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APPENDIX 1
Map of Veteran Affairs Medical Center, Denver, CO



BUILDINGS

- 1 - MAIN HOSPITAL
- 4 - GERIATRICS / HEMC
- 5 - NURSING (NACATE) DT, 7-31-40 - MUD
- 6 - ENGINEERING SHOPS
- 7 - EMS ADMIN / LABORATORY D
- 8 - BOILER PLANT
- 15 - GAS METER HOUSE
- 18 - STORAGE (AIR-VENTILATORS)
- 19 - RESEARCH
- 20 - DEEP WELL PUMP HOUSE
- 21 - RESEARCH
- 23 - RESEARCH (NCHC)
- 24 - AMBULATORY CARE / AUDIOLOGY / SPEECH PATH / CANTINE / EENT
- 25 - STANDBY GENERATOR
- 26 - PRIMARY SWITCHGEAR
- 30 - NURSING HOME CARE UNIT
- 39 - EMERGENCY GENERATOR
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- B - ENGINEERING / HEMC / HOMELESS VETS / EMS ADMIN
- C - ADMIN / FISCAL
- D - RESEARCH

APPENDIX 2
1996 Closing the Circle Award Nomination

CLOSING THE CIRCLE AWARDS 1996

Nominations Form -- Deadline: February 15, 1996

1. Category: Recycling
2. Title of Nomination: Recycling at the Denver Department of Veterans Affairs Medical Center
3. Contact Name: Bruce C. Carruthers
Acting Medical Center Director (00)
Department of Veterans Affairs Medical Center
1055 Clermont Street
Denver, Colorado 80220
Telephone: (303) 393-2800. FAX: (303) 393-2861
4. Nominee: Arnold L. Schultz, Ph.D.
Supervisory Chemist
Pathology and Laboratory Medicine Service (113)
Department of Veterans Affairs Medical Center
1055 Clermont Street
Denver, CO 80220
(303) 393-2830

Noella B. Pregill
Contract Specialist
Acquisition and Material Management Service (90C)
Department of Veterans Affairs Medical Center
1055 Clermont Street
Denver, CO 80220
(303) 393-2849

Ken Wederski
Aide, Physical Medicine & Rehabilitation Service (117)
Department of Veterans Affairs Medical Center
1055 Clermont Street
Denver, CO 80220
(303) 399-8020 ext. 3268

Robert G. Gibson
Housekeeping Aide, Environmental Management Service (137)
Department of Veterans Affairs Medical Center
1055 Clermont Street
Denver, CO 80220
(303) 399-8020 ext. 2578

Sue Lucht
Rehabilitation Planning Specialist
Physical Medicine & Rehabilitation Service (117B)
Department of Veterans Affairs Central Office
Department of Veterans Affairs Medical Center
1030 Jefferson
Memphis, TN 38104
Telephone: (901) 523-8990 ext. 7531. FAX: (901) 577-7396
5. Location: Department of Veterans Affairs Medical Center
Denver, Colorado

Printed on James River Eureka paper: 35% postconsumer + 15% preconsumer content

Abstract: The Denver Department of Veterans Affairs Medical Center began its recycling program with white office paper in April, 1991 and has expanded to include all types of office paper, corrugated cardboard, fluorescent lamps, cooking oil, newspaper, wooden pallets, printer ribbons, aluminum beverage cans, telephone directories, rubber stamps, plastic containers, and nickel cadmium batteries. The program's success is due to the Recycling Program Monitors, representing thirty five services within the Medical Center, whose responsibility is to inform the employees within their services about the various programs and to encourage them to participate. An information sheet is distributed to all new employees.

The recycling program at the Denver Department of Veterans Affairs Medical Center began in April, 1991 following the efforts of an ad hoc committee of a few people interested in preserving the environment. The committee decided to enter into recycling with a white office paper program. A voluntary network of Recycling Program Monitors representing several of the services with the largest use of computer paper within the Medical Center was established. It took a lot of convincing to get a paper recycling company to agree to set up a white paper recycling program on a trial basis. They did not believe that we could provide a large enough volume of paper to make it cost effective for them to pick up at our facility. During the first month we recycled 1.4 tons of white office paper.

The network of Recycling Program Monitors has increased and now represents thirty five different services within the Medical Center. The task of the Recycling Program Monitors is to inform the employees within their services about the various programs and to encourage them to participate. The motto of the recycling program is taken from a Kenyan proverb, "We have inherited the Earth from our parents and borrowed it from our children."

With the expansion of this group of conscientious volunteers, the office paper program now includes copy machine paper, letterhead, white tablet paper, computer printout, laser printer paper, typing paper, sticky notes, colored paper, facsimile paper, non-carbon reproduction paper, and envelopes. The quantity of office paper recycled has continued to increase. We recycled 15.5 tons of paper during the first nine months of the program, 30.2 tons in 1992, 36.4 tons in 1993, 39.3 tons in 1994, and over 40 tons for the first ten months in 1995. The proceeds, over \$2,700 to date, are deposited in the U.S. Treasury. The participants are kept informed of the success of the program through e-mail. They are not only given the weight of paper they have recycled (162.5 tons), but also the equivalent saved in terms of trees (2,762), kilowatt hours of electric power (1,690,162), barrels of crude oil (487), and cubic yards of landfill (536).

The next area that the Recycling Program Monitors decided to get involved in was the recycling of U.S. West telephone directories used in the Medical Center. This program was established in 1992 in cooperation with U.S. West. Pallets are placed for employees to recycle the old directories when they pick up the new ones. U.S. West then picks up the old directories for recycling. About 85-90% of the directories are voluntarily recycled. This evolved into a source reduction program as well as a recycling program. The Recycling Program Monitors have decreased the number of telephone directories delivered to the Medical Center by approximately 60%. They conducted a survey in each of their services to find out how many directories were actually required. That number was less than 75% of what we were receiving. We reduced the number of directories delivered to reflect that. We were getting directories for metropolitan Denver in the fall and local area directories in the spring. Another survey by the Recycling Program Monitors showed no need for the local area directories and delivery of those was discontinued.

Employees next asked about the possibility of recycling newspapers on station. A program was established in 1993 with the local chapter of the Shriners. They provide a 2 cubic yard container which they empty once a week. The Shriners utilize the proceeds in their charitable endeavors.

At about the same time, we began a voluntary program of recycling aluminum beverage cans. Collection areas were set up in the Canteen and near vending machines in the two patient waiting areas. The containers are maintained by an employee in Environmental Management Service who volunteered to do so. Approximately 20 pounds of cans are recycled each week from these two sources. There are also several services within the Medical Center that have established their own aluminum can recycling programs.

In 1993, the Medical Center began to recycle corrugated cardboard. We began with a weekly pick-up of one 6 cubic yard container. Even though this program required employees to voluntarily break down the cardboard before our Environmental Management Service employees picked it up to place in the container, through the efforts of the Recycling Program Monitors, the program rapidly expanded to four 6 cubic yard containers picked up twice a week. The program continued to grow and in June, 1994 we leased a downstroke cardboard baler. During the period of June, 1994 through October, 1995 we recycled 55.2 tons of corrugated cardboard and returned over \$1,600 to the U.S. Treasury.

The Denver Department of Veterans Affairs Medical Center participates in the x-ray film silver recovery program. In fiscal years 1993 and 1994, 1,075.10 and 992.37 troy ounces of silver were recovered, respectively. During fiscal year 1995 the amount of silver recovered from x-ray film was 1,071.70 troy ounces, an increase of 8% compared to fiscal year 1994. This totals 3,139.17 troy ounces, which is equivalent to 215 pounds, of silver that have been recovered by our facility in a three year period.

The Medical Center uses a large quantity of printer ribbons. One of the Recycling Program Monitors in Information Management Resource Service who was responsible for ordering the printer ribbons researched the feasibility of recycling the ribbons. We are now returning our used printer ribbons to a vendor who restuffs the plastic cartridges with new ribbons. As a result of this individual's efforts, during the first year of this program, 1,630 printer ribbons were recycled at a net savings to the Medical Center of \$3,420.

The Recycling Program Monitors have been the major driving force in expanding the recycling programs at the Denver Department of Veterans Affairs Medical Center. The Recycling Program Monitors meet once a quarter and also communicate thorough an e-mail group with 46 members. Their suggestions have permitted us to expand our programs to include the recycling of fluorescent lamps, cooking oil, wooden pallets, cooking oil, rubber stamps, and plastic bottles used for irrigation purposes in the operating rooms and outpatient clinics.

Fluorescent lamps are picked up for recycling on a quarterly basis. During the first two years of the program we recycled approximately 8,000 lamps that would otherwise have been treated as hazardous waste. The glass, aluminum, and mercury contained in the lamps are all recycled.

Over 100 pounds of cooking oil per week from our Canteen Service is picked up and recycled into soap products. This service is provided to the Medical Center at no cost.

Another service provided to the Medical Center at no charge keeps 70-80 wooden pallets out of the solid waste stream per month. They are repaired if necessary and reused.

Rubber stamps that are no longer used are returned to the vendor when new ones are purchased. We receive a 5% discount on new stamps. Several hundred stamps have been recycled since this program began in November, 1994.

Approximately 600 plastic bottles per month that would have otherwise gone into the solid waste stream are now distributed to several groups that use them as water bottles for hiking and sports activities. These groups include the Boy Scouts, the Sierra Club, Colorado Outward Bound, and several youth sports teams. This program began in late 1994.

An additional plastic container recycling program began in 1995. The laundry section of the Medical Center's Environmental Management Service has recycled 31 drums that various laundry products are shipped in. This included both 30 and 55 gallon drums that had previously been discarded into the solid waste stream.

Another program begun in 1995 involves recycling wet nickel cadmium batteries used by our Biomedical Section of the Medical Center's Engineering Service. We have had three pick-ups totaling 195 pounds (approximately 150 batteries). The plastic, metal, and hazardous liquid are all recycled. These batteries had previously been treated as hazardous waste.

"Environmental Minutes" are sent by e-mail to the Recycling Program Monitors several times a month. These contain information on various recycling and environmental programs available within the metropolitan Denver area. Topics have included such themes as Christmas tree recycling, leaf mulching, motor oil recycling, xeriscape, composting, household chemical roundups, compact fluorescent lamps, wire clothes hanger recycling, recycled products, and an environmental research house demonstration. These e-mail messages are forwarded by the Recycling Program Monitors and are read by almost 700 employees within the Denver Department of Veterans Affairs Medical Center.

Through the efforts of the Recycling Program Monitors and all the employees at the Denver Department of Veterans Affairs Medical Center, we have been able to recover at least a third of the material from our solid waste stream. This is evidenced by the fact that we have reduced the number of pulls of our trash compactor from three times a week to twice a week at a cost reduction of \$13,000 a year for trash hauling. We have also reduced the amount of solid waste that had been treated as hazardous waste.

The fiscal impact of the recycling programs at the Denver Department of Veterans Affairs Medical Center is minor compared to the esprit de corp that has developed in our employees and their increased awareness of recycling and environmental issues.

In 1995, to further awareness and encourage participation in our recycling programs, a poster design and logo contest was open to all the employees within the Denver Department of Veterans Affairs Medical Center. The first place entry is displayed within the Medical Center.

The various recycling programs at the Denver Department of Veterans Affairs Medical Center have received publicity in publications of both the Colorado Hospital Association and the Sierra Club.

Printed on James River Eureka paper: 35% postconsumer + 15% preconsumer content

APPENDIX 3
Veterans Affairs Pollution Prevention Strategy

DEPARTMENT OF VETERANS AFFAIRS

VA DIRECTIVE POLLUTION PREVENTION PROGRAM STRATEGIC GOAL

1. PURPOSE

The purpose of this Directive is to have Department of Veterans Affairs (VA) facilities and organizations promote the use of pollution prevention practices in accordance with the Executive Order (E.O.) 12856, "Federal Compliance with Right to Know Laws and Pollution Prevention Requirements."

2. DEFINITIONS

a. Pollution Prevention. For the purposes of implementing pollution prevention at VA facilities, "pollution prevention" means "source reduction," as defined in the Pollution Prevention Act (PPA) and other practices that reduce or eliminate the creation of pollutants through: increased efficiency in the use of raw materials, energy, water, or other resources; or protection of natural resources by conservation.

b. Source Reduction. As defined by the PPA, "source reduction" means any practice which both reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise, released into the environment (including fugitive emissions) prior to recycling, treatment or disposal; and the hazards to public health and the environment associated with the release of such hazardous substances, pollutants or contaminants. Source reduction includes: equipment or technology modifications; process or procedure modifications; reformulation or redesign of products; substitution of raw materials; and improvements in housekeeping, maintenance, training, or inventory control. Source reduction does not include practices such as incineration which alter the physical, chemical, or biological characteristics or the volume of a hazardous substance, pollutant or contaminant through a process or activity which itself is integral to and necessary for the production of a product or the providing of a service.

c. EPCRA. "EPCRA" refers to the Emergency Planning Community Right to Know Act (SARA Title III). Compliance with EPCRA is defined by criteria set out in the EPA Code of Regulations 40 CFR Part 372. VA has had a written Circular since 1992 calling for VA facilities to comply with the intent of EPCRA. E.O. 12856 now mandates that Federal facilities comply with this Act. Attachment A summarizes the content of this Circular and should be referred to by VA facilities to determine applicable EPCRA requirements.

3. BACKGROUND

a. On August 3, 1993, President Clinton signed the E.O. 12856 entitled "Federal Compliance with Right To Know Laws and Pollution Prevention Requirements". This E.O. combines requirements of EPCRA with those of the Pollution Prevention Act (PPA) of 1990.

b. VA issued VA Circular 00-92-5, "Emergency Planning and Community Right to Know Act" in 1992. As a result of this circular, VA has voluntarily complied with many of the requirements of the Emergency Planning and Community Right to Know Act (EPCRA) even though Federal facilities were not required by law at that time to comply with EPCRA.

4. POLICY

VA is committed to environmental leadership and preventing pollution by reducing the use of hazardous materials. Additionally, VA is committed to reducing the release of pollutants to the environment to as low as is reasonably achievable. VA's goal is to accomplish pollution prevention and reduce the generation of wastes through a hierarchy of actions. These actions range from the most preferred choice of source reduc-

tion, to recycling, then treatment, and disposal, as a last resort. To build a strong pollution prevention program, this hierarchy of actions must be fully integrated into day-to-day VA operations.

5. ACTION

a. VA facilities shall:

- (1) Continue to participate with local, state and Federal officials in emergency planning and community right to know activities in accordance with the "Emergency Planning and Community Right to Know Act" as required by VA Circular 00-92-5. Attachment A summarizes the content of this Circular and includes EPCRA requirements applicable to VA facilities.
- (2) Promote reducing the use of toxic and hazardous substances and the resulting generation of waste by reviewing facility operations, procedures and unit processes. To the maximum extent feasible implement source reduction measures including, but not limited to, the substitution of materials that are less hazardous and/or of reduced toxicity.
- (3) Promote the development of a VA pollution prevention ethic by addressing pollution prevention goals and actions in the development of facility guidance, policy and operating procedures.
- (4) Develop and implement methods to identify and quantify releases and off-site transfers of toxic and hazardous chemicals to all environmental media (i.e., air, soil, surface and ground water).
- (5) Develop and maintain a comprehensive inventory of toxic chemicals, extremely hazardous substances and hazardous chemicals.
- (6) Promote pollution prevention awareness through training, education, and outreach/awareness programs.
- (7) Include significant environmental costs in life-cycle or other cost estimating done in conjunction with acquisition or construction.
- (8) Purchase environmentally preferable products, when possible. Environmentally preferable products include, but are not limited to, products having recycled content, products that can be recycled after use, products that substitute less toxic or hazardous components, products that are energy efficient and products that otherwise protect the environment.

b. VA Central Office and Regional organizations shall implement pollution prevention actions as specified below:

- (1) Promote pollution prevention awareness through training, education, and outreach/awareness programs.
- (2) Incorporate pollution prevention goals and actions when appropriate in the development of guidance, policy and procedures.
- (3) Purchase environmentally preferable products, when possible.
- (4) Cognizant offices will require that new heating, ventilating, air conditioning (HVAC) and refrigeration equipment associated with projects for which they are responsible use chemicals that do not contain chlorofluorocarbons (CFCs). Additionally, when technically and economically feasible, such offices will require the use of equipment that does not contain CFCs for HVAC and refrigeration renovation projects.

c. Veterans Health Administration organizations at VA Central Office shall set pollution prevention goals and take specific actions as listed below:

- (1) Construction Management shall:
 - (a) Incorporate pollution prevention requirements in specifications for construction and construction related building systems.
- (2) Environmental Management Service shall:
 - (a) Develop policy and program guidance to implement integrated pest management using pollution prevention techniques.
 - (b) Establish an annual goal to reduce the use of toxic pesticides by a specific percentage by the year 2000.
- (3) Operations/Engineering Management and Field Support shall:
 - (a) Ensure that pollution prevention considerations are taken into account in the construction of Non-Recurring Maintenance and Minor projects.
 - (b) Incorporate pollution prevention considerations into guidance, policy and standard procedures related to facility operations and building system maintenance.

d. National Cemetery System shall:

- (1) Incorporate pollution prevention into grounds keeping operation, e.g., substitute less toxic/hazardous or non-toxic/hazardous materials for use as pesticides or fertilizers.
- (2) Establish an annual goal to reduce the use of toxic pesticides by a specific percentage by the year 2000.

e. Acquisition and Materiel Management shall:

- (1) Incorporate pollution prevention and other environmental considerations into all phases of the acquisition/procurement process including, but not limited to: requests for proposals, evaluations of proposals, contract documents and contract performance.
- (2) Revise the VA Acquisition Regulations (VAR) as necessary to implement this strategy.
- (3) Evaluate the effectiveness of alternative sterilants to ETO and, if appropriate, establish and implement a plan to reduce the use of ETO by VAMCs and other VA health care facilities.
- (4) Implement acquisition and procurement policies and lifecycle costing practices that promote pollution prevention, reduce waste, minimize effects on natural resources and encourage economically efficient market demand for items using recovered material.

f. The VA Environmental Executive will serve as coordinator for implementation of the VA Pollution Prevention Strategic Goal.

6. REFERENCES

- a. Executive Order 12856 "Federal compliance with Right to Know Laws and Pollution Prevention Requirements"
- b. VA Circular 00-92-5 "Emergency Planning and Community Right to Know Act" 1992

7. FOLLOW-UP RESPONSIBILITY: DIRECTOR, ENGINEERING MANAGEMENT AND FIELD SUPPORT OFFICE (138).

8. RESCISSIONS: THIS DIRECTIVE SHALL EXPIRE

VA DIRECTIVE ATTACHMENT A

SUMMARY OF THE EPCRA REQUIREMENTS AS THEY IMPACT THE VA

A summary of the EPCRA requirements as they impact the VA is as follows:

1. Section 301-303 of the Act (Emergency Planning)

- a. Appoint an ERC (Emergency Response Coordinator) as a point of contact for the LEPC (Local Emergency Planning Committee). The ERC should either be someone familiar with environmental and safety concerns, such as the facility Industrial hygienist or Safety Official, or should work closely with these individuals to accomplish the tasks listed below.
- b. Determine if any chemicals at the VA facility which are listed as "extremely hazardous" have a potential for release into the environment in such a manner as to be a threat to the safety and health of the community.
 - (1) Research and hospital laboratories are exempt from the reporting requirements of Section 302 of EPCRA, the "hazardous chemicals" list. VAMCs would be required to report non-laboratory storage of bulk chemicals that are stored in quantities of 10,000 pounds or more; however, it is unlikely that VAMCs store more than 10,000 pounds of any of the chemical on the "hazardous chemicals" list.
 - (2) Research and hospital laboratories are not exempt from the reporting requirements for chemicals on the "extremely hazardous chemicals" list (Sections 311 and 312 of EPCRA) if the quantities of these chemicals stored at a facility equal 500 pounds or more, or exceed the TPQ (Threshold Planning Quantity) for a specific chemical, whichever is less. There are a few pesticides that have a TPQ of 1 pound or less. VA plans to review the use of these listed pesticides and use suitable substitutes when feasible. This will reduce pollution that could result from use of these chemicals. It would also reduce the reporting requirements that may be associated with storage of these chemicals.
 - (3) Ethylene oxide (ETO) is used as a sterilant at most VAMCs. The Reportable Quantity (RQ) for an accidental release of ETO is 10 pounds. Routine releases of ETO when used as a sterilant do not have to be reported under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) regulations (40 CFR 302.8(b)). Most medical centers have permits to discharge ETO or have installed devices to prevent discharge into the atmosphere, and are, therefore, exempt from reporting this chemical.
 - (4) The toxic chemical release reporting requirement (Section 313 of EPCRA) has a reporting requirement that is based on the use of chemicals on the "toxic chemical" list in quantities of 10,000 pounds or more of any one chemical. There are no VA facilities that store or use such quantities of toxic chemicals.
- c. Provide to the LEPC a list of those chemicals which may be a potential threat and be prepared to provide MSDS (Material Safety Data Sheets) for chemicals upon request.

2. Section 302 and 303 of the Act (Storage Reporting Requirements). The ERC will provide the LEPC with the location of the bulk chemical storage (indicated on a map of the facility with building numbers and roads) of "extremely hazardous" chemicals to be reported to the LEPC in the event of a release.

3. Section 304 of the Act (Release Reporting Requirements - Emergency Notification)

- a. The VA ERC shall report to the State Emergency Response Commission and the LEPC uncontrolled releases of listed "extremely hazardous" chemicals:

- (1) That exceed the agreed upon reportable amount for the chemical and leave the physical boundaries of the installation, or
- (2) May represent an imminent or substantial endangerment to public health or the environment.

b. Chemicals subject to this requirement are substances on the list of "extremely hazardous" chemicals and substances subject to the emergency notification requirements under the CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) Section 103 (a).

NOTE: *The National Response Center must also be notified for releases exceeding the reportable quantity for substances listed under CERCLA Section 103 (A) even if the substances do not leave the physical boundaries of the facility.*

c. Information to be immediately provided in the emergency notification is as follows:

- (1) The chemical name or identity of any substances involved in the release.
- (2) An indication of whether the substance is on the SARA title III (Superfund Reauthorization Act) title III list of "extremely hazardous" chemicals
- (3) An estimate of the quantity of release into the environment.
- (4) The time and duration of the release.
- (5) The environmental medium (air, water, land) into which the release occurred.
- (6) Any known or anticipated acute or chronic health risks associated with the emergency, and where appropriate, advice regarding medical attention necessary for exposed individuals.
- (7) Proper precautions to be taken as a result of the release (such as evacuation).
- (8) Name and phone number of the contact person.

d. Follow-up written emergency notice after the release shall include the following information:

- (1) Update of information included in the initial notice.
- (2) The actual response actions taken.
- (3) Any known or anticipated data or chronic health risks associated with the release.
- (4) Advice regarding medical attention necessary for exposed individuals.

4. Section 311 of the Act: Material Safety Data Sheets, (Community-Right-to-Know). Provide MSDS information on the nature, amount, and location of "extremely hazardous" substances used or stored within the confines of our facilities, if requested by the LEPC.

5. Section 312 of the Act; Emergency and Hazardous Chemical Inventory Forms, (Community-Right-to-Know). This section applies to hazardous chemicals stored at or above 10,000 pounds and "extremely hazardous" substances at or above 500 pounds or the Threshold Planning Quantity (TPQ), whichever is less (40 CFR 370.20, 370.21, 370.40). VA facilities are unlikely to meet the 10,000 pound or the 500 pound threshold of the listed chemicals with the exception of some pesticides which have a TPQ lower than 500 pounds, and may be used in NCS or VAMCs.

6. Section 313 of the Act: Toxic Chemical Release Forms. Applies to the manufacturing and or importing, or processing of 25,000 pounds per year, or otherwise using 10,000 pounds per year of one or more listed toxic chemicals. (40 CFR 372.25). VA facilities are not required to fill out and submit EPA Form 9350-1 "Toxic Chemical Release Inventory Reporting form," since VA facilities do not meet the chemical quantity criteria of this section.

7. Compliance With State and Local Right-to-Know and Pollution Prevention Requirements. E.O. 12856 states that "Federal agencies are further encourages to comply with all state and local right-to-know and pollution prevention requirements to the extent that compliance with such laws and requirements is otherwise already mandated."

APPENDIX 4
Pay Back Analysis for PureForm 2000 Formalin Recycling System

2/26/98

B/R Instrument Corp.
PureForm™ 2000 Formalin Recycling System
Pay Back Analysis

Prepared for :

Caitlin Bowman
Environmental Engineer
Tetra Tech EM Inc.
1099 18th Street
Suite 1960
Denver CO 80202
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Monthly Usage	Formalin	100	
Unit Cost		\$8.75	
Monthly Cost		\$875.00	
Recovery		80%	
Monthly Cost Reduction		\$540.00	
Monthly Formalin Cost Reduction			\$540.00
Disposal Cost/per gallon	Formalin	None	
Monthly Disposal Cost Eliminated		N/A	
Monthly Formalin Disposal Cost Reduction			\$0.00
BUFFERING KIT , COST PER LITER (\$0.25)			\$20.00
Monthly Net Formalin Cost Reduction			\$520.00
Annual Net Formalin Cost Reduction			\$6,240.00

2/28/98

PUREFORM(R) 2000 FORMALIN RECYCLING SYSTEM	\$13,129.00
F-470 FLOOR STAND	\$792.00

Total Cost of System	\$13,921.00
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The above system is complete and ready to set up for operation.
Installation and Training Included.

A dedicated 115V AC outlet, tap water and drain, or CFT-33, and proper ventilation, are required for installation. A CFT-75 will operate 2 systems simultaneously (220V, 15A).

The purchase price also includes the following:

- Follow-up support and technical advice by telephone from B/R Instrument Corp. via our 800 line.
- B/R *Recycler* newsletter with helpful information, tips and articles about recycling.

2/26/98

Capital Cost Recovery Analysis

This analysis is prepared to determine the capital cost recovery period for B/R Instrument's Pureform® 2000 Formalin Recycling System.

Payback Period

Purchase price of Pureform® 2000 Formalin Recycling System	\$13,921.00
Payback Period in Months	27
Payback Period in Years	2.25

For ordering information please contact :
B/R Instrument Corp.
9119 Centreville Road
Easton, MD 21601
Tel. (800) 922-9206
or (410) 820-8800 (In MD)
Fax (410) 820-8141

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